INFLUENCE OF SEASONAL MIGRATION ON DIETARY PATTERN AND NUTRITIONAL BALANCE OF PASTORALIST *FULANI* CHILDREN (6-59MONTHS) IN *KAJURU* L.G.A, KADUNA STATE

BY

NURAINI, AISHA

DEPARTMENT OF BIOCHEMISTRY

FACULTY OF LIFE SCIENCES

AHMADU BELLO UNIVERSITY,

ZARIA, NIGERIA

APRIL, 2018

INFLUENCE OF SEASONAL MIGRATION ON DIETARY PATTERN AND NUTRITIONAL BALANCE OF PASTORALIST *FULANI* CHILDREN (6-59MONTHS) IN *KAJURU* L.G.A, KADUNA STATE

BY

Aisha, NURAINI
Food Science and Nutrition (FUTMINNA) 2010
MSc/Sci./33542/12-13; P16LSBC8041

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, IN PARTIAL FULFILLLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER OF SCIENCE DEGREE IN NUTRITION

DEPARTMENT OF BIOCHEMISTRY

FACULTY OF LIFE SCIENCES

AHMADU BELLO UNIVERSTY,

ZARIA, NIGERIA

APRIL, 2018

DECLARATION PAGE

I declare that the work in this Dissertation entitled "Influence of seasonal migration on dietary pattern and nutritional balance of pastoralist *Fulani* children (6-59months) in K*ajuru* L.G.A, Kaduna state**"** has been carried out by me in the Department of Biochemistry. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other Institution.

Aisha Nuraini	_____	_____
Name of Student	Signature	Date

CERTIFICATION PAGE

This dissertation entitled "INFLUENCE OF SEASONAL MIGRATION ON DIETARY PATTERN AND NUTRITIONAL BALANCE OF PASTORALIST *FULANI* CHILDREN (6-59MONTHS) IN K*AJURU* L.G.A, KADUNA STATE" by Aisha NURAINI meets the regulations governing the award of the degree of "MSc Nutrition" of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

Professor D.A. Ameh		
Chairman, Supervisory Committee	Signature	Date
Dr. Salihu Aliyu		
Member, Supervisory Committee	Signature	Date
Professor M.S. Nasir		
Head of Department	Signature	Date
Professor S. Z. Abubakar		
Dean, School of Postgraduate Studies	Signature	Date

ACKNOWLEDGEMENTS

I would first give glory to God for giving me the strength and ability to carry out the work; it was really challenging and interesting.

A big appreciation goes to my Supervisor Prof. D. A. Ameh particularly for providing the inspiration for the topic; I thank him for his patience, guidance and advice.

I would also like to express my gratitude to my other Supervisor Dr. A. Salihu for his guidance and tireless effort in correcting my work.

My gratitude also go to Mr Owolabi Olumuyiwa A. for his immense contributions by taking time to also go through my work and also respond to my many questions. Many thanks to Mallam Sani Mohammed, the chief Lab Scientist at the ABU University Clinic; he was always willing to provide support, advice and assistance; my sincere appreciation for ensuring all my analysis were duly carried out.

I will like to highly appreciate the support of the Chairman Miyetti Allah Cattle Breeders of Nigeria Alhaji Ahmadu Suleiman and his sons including *Ardo* Musa (District Head of Fulani in Kajuru); their cooperation was key to the success of the work not forgetting my community guide all through the field work Musa Jaye; he was valuable in locating the various settlements even hard-to-reach areas.

I would like to appreciate my beloved mother for her moral and financial support including my brother for their continuous encouraging words that helped me all through the research; Though I lost my dad (May his soul rest in peace) during the period of research, a good friend of his Mr Isiaka Haruna gave me both motivational and financial support that helped me cope and I would like to say express my great appreciation for his support.

Thanks are due also to all my beloved friends including Maryam, Hamsatou, Bola, Hussaina, Michael and many others I cannot mention but I appreciate them all. Finally my acknowledgement goes to the villagers and the families in Kajuru LGA for their cooperation during the period of data collection. Though there were various security challenges at the time, the hospitality shown by the people made the work delightful and a good experience.

DEDICATION

This work is dedicated to Abduljalal Ibrahim Chiroma

ABSTRACT

Seasonal effects on child growth have rarely been investigated and very little information exists on the nutritional status of pastoralist Fulani children (6-59months). Data from such study could serve as a baseline for future studies, as well as informed public health policy. The aim of this study was to assess the impact of seasonal migration on dietary pattern and nutritional balance of pastoralist Fulani children (6-59months) in Kajuru L.G.A. A semi structured and food frequency questionnaire were used to collect socio-demographic and dietary information respectively. Height and weight of 581 and 145 children was measured after migration and upon return from migration respectively. This was analyzed using ENA for SMART to assess levels of malnutrition. Blood samples were also collected for analyses of some micronutrients; albumin and haemoglobin concentration were analyzed using Hemocue Analyzer on the field. The prevalence of stunting, underweight and wasting during the dry season were 23.4%, 20.3% and 14.5% respectively and during the Wet season, the prevalence of stunting, underweight and wasting were recorded at 37.2%, 13.1% and 4.8% respectively. Boys were more severely wasted (3.0%) than girls (2.5%) while girls showed a higher percentage of severe underweight (6.8%) compared to boys (3.3%) and for stunting boys showed a higher percentage (12.5%) than girls at 7.6%. Overall, the age group that had highest percentage of wasting, stunting and underweight was children between 6-24months. The concentrations of micronutrients were normal in over 50% of pastoralist Fulani children measured during both seasons; 54% and 67% of children had normal serum albumin levels during dry season and wet seasons respectively. According to the WHO thresholds, the prevalence of Global Acute Malnutrition was serious (10-14%) during the dry season only and stunting was the only under-nutrition indicator of high prevalence during both seasons and this may be due to some underlying conditions associated with malnutrition such as poor dietary intake, infant feeding practices among others. Nutrition education, hygiene promotion and improved access to health care services may help reverse these trends.

Table of Contents

Page

LIST OF TABLES

Table **Page Number**

LIST OF FIGURES

Figure **Page Number**

LIST OF APPENDICES

Appendix **Page Number**

LIST OF ABBREVIATIONS

ACF	Action Contre la Faim also known as Action Against Hunger International
C.I.	Confidence Interval
CMR	Crude Mortality Rate
CMAM	Community management of acute malnutrition
CRC	Convention on the Rights of the Child
ENA	Emergency Nutrition Assessment
FAO	Food and Agriculture Organization
GAM	Global Acute Malnutrition
GDP	Gross Domestic Product
HAZ	Height for Age Z score
ICN	International Conference on Nutrition
IYCF	Infant and Young Child Feeding
INGO	International Non-Governmental Organization
LNGO	Local Non-Governmental Organization
MAM	Moderate Acute Malnutrition
MICS	Multiple Indicator Cluster Survey
MUAC	Mid Upper Arm Circumference
NDHS	National Demographic Health Survey
SAM	Severe Acute Malnutrition
SMART	Standardized Monitoring and Assessment of Relief and Transitions
UNICEF	United Nations Children Fund
WFP	World Food Programme
WHZ	Weight for Height Z score

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Malnutrition is perhaps the most important problem facing the poor people in the World today; in spite of the progress made in improving nutrient availability in the last decade, a large proportion of poor households in developing countries still have inadequate access to sufficient food (Abdulai and Aubert, 2004). Good nutrition is increasingly perceived as an investment in human capital that yields returns today as well as in the future, while bad nutrition is a threat to the nation; good life nutrition raises returns on investment in education and health care (Ezekwe, 2008). Inadequate consumption of protein and energy as well as deficiencies in Key micronutrients such as iodine, Vitamin A and Iron are key factors causing morbidity and mortality of children; malnourished children have lifetime disabilities and weakened immune systems (Ezekwe,2008).

Pastoralism is a livelihood based on livestock rearing which is experienced by sedentary or mobile communities; traditional pastoral production systems of Africa may be classified (in order of increasing mobility) as agro-pastoralism, sedentary pastoralism, semi-sedentary-pastoralism (transhumance) and nomadic or migratory pastoralism (Schwartz, 1993). In general, mobility is used to manage uncertainty and risks such as feed and water scarcity associated with drought and diseases in arid and semi-arid ecosystems (Admassu, 2003).

Many traditionally mobile populations continue to depend on production of various livestock species such as cattle, sheep, goats, camels, yak, horses and donkeys to provide animal source foods that can be sold for income or directly consumed (Randolph *et al*., 2007). Such livestock-dependent “pastoralists” use mobility to manage uncertainty and risk (Schelling,

2005), and generally move with their herds in response to animal needs, seasonal changes in habitat, socio-political arrangements for land use and access, and attimes violent conflict. Mobile pastoralists typically inhabit areas unsuitable for agriculture and industry, such as high altitude, high latitude (Zinsstag *et al*., 2006) and/or arid and semi-arid ecosystems, which are often far from major centres of high population density and infrastructural investment (Munch, 2007; Weibel, 2008). Migratory movements represent a complex response to a mix of abiotic, biotic and human social factors, including conflict (Dyson-Hudson and Smith 1978, Gray *et al*., 2003).

The Nigerian pastoralists are made up of various ethnic groups but the largest group of pastoralists is the Fulbe or Fulani that constitute about 95 per cent of the nomadic herders in Nigeria bearing at least thirteen names in West Africa, and found in more than twenty countries, the Fulani make up the continent's most diffuse ethno-cultural group (Islam, 2001). The population of Fulani nomads in Nigeria are high; based on the report of nomadic education extension services in 2002, Iliyasu (2012) estimated their number to be six million.

The Fulani are mostly semi-settled, moving to locations where seasonal water supplies make pasture available during the dry season. However, some Fulani are nomadic and are constantly on the move in search of water and pasture. They keep large herds and depend on milk and dairy products for sustenance. The Fulani are the most vulnerable to diseases and natural hazards; their mobility exposes them to common colds and allergies associated with dust, weeds, and animals due to unprotected bodies exposed to bites or stings from bees, snakes, scorpions, mosquitoes, house flies, and tsetse flies and also the Fulani's drink water that is polluted with dirt and decomposing matter (Iro, 2004).

The Fulani indisputably represent a significant component of the Nigerian economy. They constitute the major breeders of cattle, the main source of meat, the most available and cheap

source of animal proteins consumed by Nigerians (Eniola, 2007). The Fulani own over 90% of the nation's livestock population which accounts for one-third of agricultural GDP and 3.2% of the nation's GDP (Eniola, 2007). Furthermore, the contribution of the Fulani to the local food chain and national food security cannot be overstressed. The Fulani, with their dominance in the Sahel region, are the best known and most numerous of all the pastoral groups in Nigeria. The traditional and unique Fulani encampment (*ruga*) consisting of temporary structures made of stalks, closely knit family members and livestock is the natural habitat of the orthodox Fulbe settlement (Eniola, 2007).

Bruijin and Dijk (1995) and Nori *et al*., (2005) have assessed the sources of vulnerability in Fulbe pastoral system. It is shown that both the sources they control (animals) and do not control (land, water, market, politics) have direct and significant impacts on their livelihoods.

Globally, access to land, credit and property rights has a further impact on child survival prospects. Marginalized groups living in informal settlements, illegal dwellings or urban slums are vulnerable to health threats. These factors also create barriers to demand, impeding the initial and continued use of services by the most disadvantaged. When combined with low rates of immunization, this situation exacerbates the transmission of diseases (UNICEF, 2015).

1.2 Statement of Research Problem

Populations that abandon livestock-keeping for life in towns or farms often suffer worse nutritional hardships, particularly the loss of protein from milk and meat, resulting in worse malnutrition, especially for children (Hilderbrand, 1985; Nathan *et al.*, 1996). High morbidity

and mortality levels among nomadic and semi-nomadic pastoral populations raise some of the world's most problematic issues in terms of public health (Zinsstag *et al*., 2004).

Some argue that nomads have better health status than their sedentarized agricultural counterparts while others point out differences due to social or geographical isolation (Foggin *et al*., 1997). For instance, some studies have shown that some nomadic communities are less affected by intestinal parasites or demonstrate a lower susceptibility to waterborne diseases such as cholera and hepatitis (Nathan *et al*., 1996). In contrast, other inquiries have indicated the propensity of pastoralist populations to suffer from specific kinds of morbidity as well as from higher rates of infant/child mortality than those of settled agriculturalists; these trends are usually attributed to differences between nomadic pastoralists and crop farmers, of nutritional status, maternal diet, child care practices (Chabasse *et al*., 1983; Brainard, 1986).

These trends are usually attributed to differences, between nomadic pastoralists and crop farmers, of nutritional status, maternal diet, child care practices (Chabasse *et al*.,1983). The dual perspective about risks to the health status of nomads mentioned above can be explained to a large degree by the effects of geographic mobility (Loutan, 1989). On the one hand, it has been observed that regular pastoral migrations, population dispersion and low human density may protect nomadic populations from epidemics while they may also introduce some diseases to non-contaminated areas (Loutan, 1989). On the other hand, however, one of the side effects attributed to spatial dispersion which is widely recognized as deleterious is the consequence of geographic barriers to the effective use of the health care system (Hampshire, 2002).

Studies to determine the predominant diseases and nutritional status among nomads are rare or dated and, therefore, the health status of nomadic pastoralists in the Northern Guinea Savannah is not well known (Swift *et al*., 1990). Yet, such information is crucial for the definition of research and action priorities and appropriate health policies for nomadic people to reduce health inequalities. Furthermore, the heterogeneity of nomad populations makes it necessary to identify the groups or sub-groups who carry the highest burden of specific diseases prior to designing a strategy to deliver efficacious health care (Tanner *et al*., 1993).

Seasonal morbidity patterns of semi-nomadic Fulani differ considerably from those of settled ones (Hill, 1985). Loutan (1989) and Swift *et al*., (1990) summarised five main factors affecting the morbidity patterns in nomadic pastoralists: (i) proximity to animals, (ii) a diet rich in milk, (iii) mobility and dispersion with resulting difficulties in getting and maintaining treatment, (iv) the special environment (hot, dry and dusty), and (v) socioeconomic and cultural factors including the presence or absence of traditional healers.

1.3 Justification

Anthropometric indicators are useful, as they provide a simple and practical way of describing the problem in the community; they are possibly the best general proxy for constraints, such as dietary inadequacies, infections and other environmental risks, on the well -being of the poorest (Shetty, 2002). Anthropometric indicators are strong and easily obtainable predictors at the individual and population level of subsequent morbidity, functional impairment and mortality, i.e. the consequences of poverty and hunger; they are reliable indicators for measuring the success or failure of interventions at the micro level and for measuring the impact of macro level changes (Shetty, 2002). Pastoral societies often represent complex but poorly analysed systems, tending to be denigrated by policy-makers

(Nori, 2007). Prevalence of anaemia and deficiencies of iron, zinc, vitamin A, riboflavin and other micronutrients are unknown for most pastoralist populations; we also lack data on birth weights and gestation length with which to assess fetal nutrition (Pike, 2000).

Mobility often improves human health as part of a suite of pastoralist adaptations that are continually responding to new opportunities and challenges (Fratkin *et al*., 2004; Schelling *et al*., 2005; Ekpo *et al*., 2008; McCabe, 1994; Nathan *et al*., 1996; Fratkin *et al*., 1999), but it also imposes constraints on the determinants of human health and well-being (Hampshire, 2002; Mocellin and Foggin, 2008; Pike *et al*., 2010), such as challenges to effective public health surveillance and intervention (Bonfoh *et al*., 2007; Tanner and Zinsstag 2009; Weibel 2008; Wyss, *et al*., 2003; Zinsstag, 2009). Concerns raised about human health and well-being among mobile pastoralists include an apparently high prevalence of micronutrient malnutrition, or "hidden hunger" as it is termed in advocacy and policy development, and the issue of how to better measure and address it however, the specific ways in which pastoralist mobility improves or undermines micronutrient consumption remain poorly investigated (Sellen, 2010).

In Nigeria, the contribution of the Fulani to the local food chain cannot be over emphasised. More than 80% of Nigerians depend on the pastoral Fulani for meat, milk, cheese, hair, honey, butter, manure, incense, animal blood, hides and skins. (Iro, 2004). Thousands of Nigerians wholly or partly make a living from selling, milking, butchering, or transporting herds and the government earns revenue from cattle trade (Iro, 2004). The Fulani, therefore, play an important role in the economy and nutrition of Nigeria; therefore an assessment of pastoralist children's (6-59months) nutritional status would help in the identification of nutritional deficiencies and risks of disease and such information may be utilized towards the provision of nutritional support and nutrition.

Kaduna State lies within the sub-humid agro-ecological zone of north central Nigeria; this zone has an annual rainfall ranging from 600 to 1000 mm. The area is suitable for the production of crops such as sorghum, yam and maize. The state also provides a dry season sanctuary for cattle because of its relatively high rainfall, which supports the growth of pasture. The cattle population of the state is estimated at 1.007 million head; more than 90% of these are owned and managed by traditional, semi-settled pastoralists (RIM 1992).

1.4 Aim

The general aim of this study is to assess the impact of seasonal migration on the dietary pattern and nutritional balance of pastoralist Fulani Children (6-59months) in *Kajuru* Local Government Area of Kaduna State.

1.5 Specific Objectives

The specific objectives were to determine the:

i. nutritional status of the pastoralist Fulani Children (6-59months)

ii. feeding pattern of the Pastoralist Fulani households

iii. status of albumin, haemoglobin and some micronutrients (Iron, zinc) concentration of Pastoralist Fulani Children (6-59months).

iv. influence of seasonal migration on the nutritional status, feeding pattern, micronutrient status, albumin and haemoglobin concentration of the Pastoralist Fulani Children (6-59months).

1.6 Null Hypothesis

There is no significant effect of seasonal migration on dietary pattern and nutritional balance of pastoralist Fulani children (6-59months) in Kajuru LGA, Kaduna State.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Nutrition and Health

The World Health Organisation (WHO, 1986) considers that poor nutrition is the single most important threat to the world's health. The saga of human nutrition and the improvement of human health have been reflected in the effort of many scientists who have belief that human performances and wellbeing, both physical and mental depends primarily on what is eaten (FAO, 2003). Nutrition is an important factor in health and disease (Blaney, 2009).

Nutrition is the science of food value. It is concerned with the social, economic, cultural and physiological implications of food and eating. Nutrition science is the area of knowledge regarding the role of food in the maintenance of health (Srilakshmi, 2006). Regardless of the state of health, adequate nutrition is important, poor nutrition might lead to a variety of health problems and may even make them worse (Marcia, 2007). According to the World Health Organization (WHO, 1986), health is defined as the 'state of complete physical, mental and emotional well-being not merely the absence of disease or infirmity.

Nutritional security exists when food security (or when the secure access to adequate nutritious food) is coupled with a favourable health environment, adequate health, care services and suitable feeding practices in order to ensure a healthy life for all members of the household (SUN, 2010).

2.1.1 Types of nutrition

Nutrition can be divided into two categories namely good nutrition i.e. optimum or adequate and malnutrition which can either be over nutrition or under nutrition; good nutrition leads to

the Physical wellbeing while malnutrition leads to ill health (Chopra *et al*., 2003). Good nutrition is perceived as a key stone of preventive health care needs. It prevents the problems from malnutrition and other diseases, improves the body's immunity and assists in the prevention of major diseases (Osilesi, 1992). Virtually all humans see eating as a means of comfort, security, prestige, indulgence, or health and emotional connotation and often a status or means of expression (Beal, 1990).

Malnutrition includes both nutrient deficiencies and excesses and is defined by the World Food Programme as a state in which the physical function of an individual is impaired to the point where he or she can no longer maintain adequate bodily performance processes such as growth, pregnancy, lactation, physical work, and resistance to and recovering from disease (WFP, 2005). Malnutrition results in disability, morbidity, and mortality, especially among infants and young children (Pelletier, 1995). Child malnutrition is linked to poverty, low levels of education, and poor access to health services, including reproductive health and family planning (IFPRI, 2014).

Under-nutrition includes being underweight for one's age, (underweight), too short for one's age (stunted – Chronic under-nutrition), dangerously thin for one's height (wasted – acute under-nutrition), deficiency in vitamins and minerals (micronutrient malnutrition) (FAO, 2010). The different types of under-nutrition are not necessarily exclusive and they often co-exist within the same child; Africa has the highest prevalence of hunger, with one out of three individuals being undernourished (FAO, 2010).

2.2 Nutritional Status

International Conference on Nutrition in Rome stated that nutritional status is defined by the nutrient content of food consumed in relation to requirements that are determined by sex, age, level of physical activities and health status as well as the efficiency of nutrient utilization by the body (ICN, 1997). The nutritional status of any person is his/her health as dictated by the quality of nutrients consumed, and the body's ability to utilize them for its metabolic needs thus, being nutritionally vulnerable, under-5 children's nutritional status is generally accepted as an indicator of the nutritional status of any particular community (Davidson *et al*., 1975). This is due to their susceptibility to malnutrition and infection (Akinlosotu and Hussain, 1985).

An individual nutritional status reflects the degree to which physiological needs for nutrients are being met. Nutrient intake depends on actual food consumption, which is influenced by factors such as eating behaviours, economic situation, emotional states, cultural influence, effects of various diseases on appetite and ability to consume and absorb adequate nutrients (Mahan and Stump, 2000). A lot of factors are collectively responsible for either good or bad nutritional status; among the factors are poor dietary intake, lack of nutritional information and bad environment situation. The nutritional status of an individual involves interplay of genetic predisposition with environmental factors (Dupuy *et al.*, 2011). These factors include age, sex, education, occupation, income, ethnicity, and knowledge and attitude related to diet and health (Dunneram and Jeewon, 2013**).**

2.2.1 Anthropometric assessment of nutritional status

Nutritional history and current dietary intake data provide information on a population's groups or individual's nutritional status and identify potential nutritional problems (Woods,

2006). Anthropometric information can be used to determine an individual's nutritional status compared with a reference mean, it can also be used to determine the prevalence of malnutrition in a surveyed population; anthropometry has become a practical tool for evaluating the nutritional status of populations, particularly of children in developing countries (Hakeem *et al.,* 2004) and nutritional status is the best indicator of the global well-being of children (Onis *et al.,* 1980).

The basic information and measurements that constitute anthropometric measurements in children are: Age, Sex, Length, Height, Weight, and Oedema; these measurements are the key building blocks of anthropometrics and are essential for measuring and classifying nutritional status in children under 5 years. Physical growth of children (less than 5 years) is an accepted indicator of the nutritional well-being of the population they represent (WFP, 2000) Mid upper arm circumference (MUAC) is a rapid method of assessing nutritional status, without requiring extensive training, supervision, or materials (Goossens *et al*., 2012).

Growth is an increase in size, its progress is mainly structural, and can be measured with some degree of reliability in terms of height, weight, age etc. (Apley, 1979). There are wide variations in the rates at which the height and weight of children are subsequently attained. This is as a result of several factors such as quality and quantity of food, family income, family size and genetic constitution which may contribute to these variations (Beaton *et al.*, 1990). Growth assessment has been identified as the most important measure for evaluating the health and nutritional status of Under-5 children through anthropometric measurements (Apley, 1979).

The reason for this is that anthropometric indicators of growth not only provide information on health and nutritional status, but is also an indirect measure of the quality of life of an entire population (Shetty and James, 1994). The nutritional status of individuals and families provides a useful outcome measure by which to assess the effects of socioeconomic and other differences within a population; the nutritional status of a population serves as a valid index of a variety of other health and socioeconomic indicators (Sellen, 1996)

Adults and older children can access proportionally larger reserves of energy than young children during periods of reduced macronutrient intake but the youngest individuals are most at risk for malnutrition and the survey results of the under-5-years population are used to draw conclusions about the situation of the whole population, not just of that age group (WFP, 2000).

According to a WHO Working Group (1986), appropriate height-for-age of a child reflects linear growth and can measure long- term growth faltering or stunting, while appropriate weight for-height reflects proper body proportion or the harmony of growth; weight-for-height is particularly sensitive to acute growth disturbances and is useful to detect the presence of wasting; weight-for-age represents a convenient synthesis of both linear growth and body proportion and thus can be used for the diagnosis of underweight children. The presence of under-nutrition in children is assessed using these three anthropometric parameters (weight-for-age, height-for-age and weight-for-height) and by comparing them with internationally accepted reference standards. Under-Nutrition diminishes immunity to disease, which, of itself, depletes nutritional status – a vicious, deleterious cycle for children (Akachi *et al.*, 2009).

2.3 Malnutrition in Children

There is consensus within the recent literature on many of the determinants of children's overall nutritional status. These include sufficient access to food, healthcare, and an improved water source, the sanitation and caring practices of the child's mother, and the mother's education level (Garett *et al.*, 1999). Research has also found strong linkages between food prices and nutritional outcomes (Lavy *et al.*, 1996). Other determinants tend to affect specific measures of nutritional status. Indicators of income and food security, or their proxies, have a greater impact on height-for-age (HAZ), a measure of long-term dietary inadequacy (Khuwaja *et al*., 2005). The same is true for maternal stature (Mamabolo *et al.*, 2007). Alternatively, recent illness typically affects weight-for-height (WHZ), an indicator of acute dietary deficiency (Ruel *et al.*, 1999).

Globally, 45% of mortality for children under five years of age is attributable to various forms of malnutrition, of which stunting is a significant contributor (Black *et al*. 2013). From birth to 4-6 months of life, breast milk is the sole or prime source of nutrients and optimal breastfeeding practice becomes a critical factor in child survival and development (Onyesili, 2000). Breast milk contains all nutrients, antibodies, hormones and antioxidants that an infant needs to thrive (UNICEF, 1998). Early initiation within half an hour of birth will ensure that the protective antibodies in the colostrum are available rapidly to the infant, because after 24 to 48 hours, the level of antibodies in breast milk diminishes (UNICEF, 1998). Malnutrition arises from a complex of nutritional, social and biological deprivation and is manifested in various forms such as stunting, underweight, muscle wasting, growth retardation with high mortality rate (Onimawo *et al*., 2006).

Growth stunting constitutes the most common evidence of marginal malnutrition throughout the world; protein and energy deficiency were initially evaluated as major causes of stunting (Sepu´ lveda Amor *et al*., 1995). During childhood, energy needs are higher than in adults and in young children the proportion of vital organs is much more important than the energy stocks; this explains why, in periods of stress and food shortages children are the first to be affected (ACF, 2012). Stunting is typically defined as low height-for-age, but, more specifically, it is a deficit of linear growth and failure to reach genetic potential that reflects long-term and cumulative effects of inadequate dietary intake and poor health conditions (ACC/SCN 2000).

The prevalence of Severe Acute Malnutrition (SAM) is higher among young children and declines after 24 months of age; conversely, chronic malnutrition progressively increases to reach a plateau at age 24 months (Victora, 1992). Breastfeeding can reduce infant mortality among children below five years of age by 12% to 20%, more than any other preventative measure (Black *et al*., 2008). The essential role of breastfeeding and complementary feeding as major factors in child survival, growth and development is backed by a weight of scientific evidence (Jones, 2003). Early initiation of breastfeeding significantly reduces the risk of neonatal death; a non-breastfed infant living in poor sanitary conditions is between six and twenty-five times more at risk of dying from diarrhoea than a breastfed infant (Lutter, 2010).

2.3.1 Malnutrition statistics in Nigeria

There was a decrease in prevalence of stunting in 2003 with 11 % of children wasted, 24 % under-weight, and 42 % of children stunted (NDHS, 2003). By 2008 prevalence of underweight had decreased to 23 % and stunting had dropped to 41 % but wasting increased to 14 % (NDHS 2008). Additional studies have also shown that malnutrition is more

pronounced in rural areas and rural children are more disadvantaged than urban children in Nigeria (UNICEF 1998; NDHS 2008; MICS 2011;; NDHS, 2013).

It is evident from the 2013 NDHS that the proportion of children who are stunted has been decreasing over the years. However, the extent of wasting has worsened, indicating a more recent nutritional deficiency among children in the country; prevalence of stunting decreased to 37 %, with a higher concentration among rural children (43 %) than urban (26 %). It was also reported that there was increase in the proportion of children underweight (29 %) and wasted (NDHS, 2013).

The report computed from the NDHS 2013 on nutritional status in northern Nigeria revealed that household economic status has a positive effect on child nutrition; additional important factors in nutritional status include maternal education; the quality of healthcare facilities for women and children (which is particularly poor in the northern states); immunization levels; and women's in-comes, livelihoods, and overall empowerment (Murphy, 2013). Malnutrition contributed to 53 % of deaths among children under five in Nigeria, and levels of wasting and stunting are still very high (UNICEF, 2007).

2.3.2 Chronic under-nutrition

A child exposed to inadequate nutrition or bouts of disease for a long period of time will grow more slowly than other children of the same age who are not exposed to poor nutrition or disease; as the development of stunting is a slow, cumulative process, it may not be evident for some years, by which time nutrition may have improved (Save the Children UK, 2004). A child's brain development is complete by age 2 and malnutrition during this time increases the risk of developmental and cognitive delays in children (Wachs *et al*. 2014). As

such, stunting is a marker for both chronic malnutrition and consequently poor child development outcomes. Stunting often begins in the uterus due to poor maternal nutrition and continues during the first 2 years of life due in part to inadequate hygiene, infant and young child feeding practices, and reflects a failure to reach one's genetic potential for height (Frongillo, 1999).

Other immediate causes of stunting include maternal and child infections and underlying causes related to hygiene, sanitation, and poverty while all children have the ability to grow at the same rate until age five, stunting often goes unrecognized because children live in communities where short stature is so common that it seems normal, or because its serious consequences are not widely understood (Alive and Thrive Technical Brief, 2000). It is estimated that children under the age of five who are born to the shortest mothers (less than 145 centimetres) have a 40 % increased risk of mortality (Ozaltin *et al.,* 2010).

A stunted child may have altered socio-emotional behaviours, including increased apathy, and reduced activity, play, and interest in exploring their environment (Gardner *et al*., 1999). This lack of interest in exploring their surroundings and negative behaviours often reduce the level of stimulation children receive from their interactions with the environment and their caregiver, further impeding their development (Yousafzai *et al*., 2012). Chronic Under-nutrition is almost certainly due to a very complex interaction of multiple mechanisms (genetic, nutritional, environmental, social and economic) and whilst little is known about the causes of growth failure, it is assumed that repeated illness in childhood, deficiencies of certain micronutrients, inappropriate feeding or care practices, etc. also contribute greatly.

Height and weight are sensitive indicators of overall health, height is considered to be a more accurate measure of growth process (Saxena *et al*., 2000). In fact, stunting is indicated by a low height-for-age and indeed, height for age at 2 years is the best health indicator of human capital (Victoria *et al*, 2008). More generally, growth failure may be regarded as an indication of poverty which is caused by gender discrimination, limited access to food, health care and education and insufficient knowledge about child nutrition (IFAD, 2001).

In low and middle-income countries in 2012, inadequate drinking water, sanitation and hygiene accounted for around 1,000 under-five deaths per day (WHO, 2014). Research in Nigeria suggests that lack of access to improved water and sanitation facilities may elevate the risk of mortality specifically, the prevalence of open defecation are also implicated in stunting because they expose children to health problems that can interfere with normal growth (Osita, 2014). Household wealth is one determinant of a child's chance to survive, but maternal education is also a strong predictor; across much of South Asia and sub-Saharan Africa, children with mothers who received no education are almost three times as likely to die before age 5 as children of mothers with secondary education (APR, 2015). Education enables women to delay and space births, secure access to maternal and child health care and seek treatment for children when they fall ill (APR, 2015).

2.3.3 Under-weight and acute under-nutrition

The pre-schoolers especially those at the second year of life are 'transitional' in relation to diet, immunity to infections and psychological dependency (Pyke, 1979). This is the period characterized by high nutrient need, particularly that of protein for swiftly increasing muscle tissue hence several meals a day is required of food which is easily masticable and digestible (Pyke, 1979). Psychological trauma also occurs as a result of the sudden separation from the

mother after a prolonged period of continuous intimate contact, and permissive breast feeding (Pyke, 1979).

Wasting or thinness indicates in most cases a recent and severe process of weight loss, which is often associated with acute starvation and/or severe disease however, wasting may also be the result of a chronic unfavourable condition (Victora 1992). Rising food prices, food scarcity in areas of conflict, and natural disasters diminish household access to appropriate and adequate food, all of which can lead to wasting which demands emergency nutritional interventions to save lives (WHO, 2014). Lack of evidence of wasting in a population does not imply the absence of current nutritional problems: stunting and other deficits may be present (Victora, 1992). Provided there is no severe food shortage, the prevalence of wasting is usually below 5%, even in poor countries. (Victora, 1992) On the severity index, prevalence between 10-14% are regarded as serious, and above or equal 15% as critical (WHO, 1995).

2.4 Micronutrient Deficiencies

Micronutrient deficiency or hidden hunger occurs when essential vitamins and/or minerals are not present in adequate amounts in the diet; it is a serious public health concern in most developing countries that has devastating effects on vulnerable groups, including pregnant and lactating women and children under five (WFP, 2005). One in three people in developing nations are affected by deficiencies in micronutrients; in Nigeria, those deficiencies are primarily in iodine, iron, and vitamin A (Bryce *et al*., 2013). If left unchecked, micronutrient deficiencies can lead to irreversible physical consequences, which is why they are considered a major health issue deserving international attention; micronutrient malnutrition is responsible for a significant share of infant mortality (Bryce *et al*. 2003). According to WHO,

2009 deficiencies in iron, vitamin A and zinc each rank among the top 10 leading causes of death in developing countries; Micronutrient deficiencies represent a particular threat to the health of children under 5 years and pregnant women.

2.4.1 Common types of micronutrient deficiencies

Anaemia is one of the most common and intractable nutritional problems in the world today; the World Health Organization (WHO) estimates that some two billion people are anaemic (<11g/dl) defined as haemoglobin concentrations that are below recommended thresholds (WHO, 2001). The main causes of anaemia are: dietary iron deficiency; infectious diseases such as malaria, hookworm infections and schistosomiasis; deficiencies of other key micronutrients including folate, vitamin B12 and vitamin A; or inherited conditions that affect red blood cells (RBCs), such as thalassemia (WHO, 2001). Socio-economic factors also have an important role in iron deficiency especially in developing countries (Sarma and Naidu, 1984; Khanum, 1985).

Anaemia prevalence is high in children and its cause is frequently multifactorial. It has been estimated that about 40% of the world′s population (more than 2 billion individuals) suffer from anaemia with a prevalence of 48% in school-aged children (WHO, 1996). Anaemia occurs as a result of abnormally low haemoglobin due to pathological conditions. Iron deficiency is one of the most common causes of anaemia, other causes include chronic infections such as malaria, worm infestation, hereditary haemoglobinopathies and other micronutrient deficiency particularly folic acid (Yip and Dallman, 1988).

The prevalence of iron deficiency is usually detected by low serum ferritin concentrations while iron deficiency anaemia is typically diagnosed by haemoglobin concentrations,

accompanied by biochemical evidence of iron deficiency such as low serum ferritin concentration (Echendu *et al.*, 2003). Anaemia among school-aged children (5-14 years) is defined as haemoglobin levels of 11g/dl or PCV of 34% (WHO, 1993). Poor nutrition especially iron deficiency in school-aged children is associated with retardation of growth and poor cognitive development (Pollit, 1997). The school age children are at risk of iron deficiency because of an expanding red cell and muscle mass (Herbert, 1992).

It is estimated that some form of zinc deficiency affects about one-third of the world's population, with estimates ranging from 4% to 73% across sub regions; worldwide, zinc deficiency is responsible for approximately 16% of lower respiratory tract infections, 18% of malaria and 10% of diarrhoeal disease (WHO, 2002). In total, 1.4% of deaths worldwide were attributable to zinc deficiency. Serum and plasma zinc concentrations are the most widely used biochemical markers of zinc status (WHO, 2002).

Iodine is essential for the normal growth and development of the human body. It is required for the production of thyroid hormones, which are necessary for normal brain development (WHO/UNICEF/ICCIDD, 2007). Insufficient intake of iodine in the diet causes a myriad of health problems collectively known as Iodine Deficiency Disorders (IDD); the health consequences of IDD include mental retardation, goiters, growth retardation, and increased neonatal and post-natal mortality. Lack of iodine at conception causes maternal hypothyroidism, which has dramatic consequences for the foetus, including severe and irreversible brain damage. It is estimated that 2 billion people, or 30.6 percent of the global population, have insufficient iodine intake, including 59.7 million school-aged children in Africa (UNICEF 2007; de Benoist *et al*., 2007. The most devastating outcomes of iodine deficiency are increased perinatal mortality and mental retardation – iodine deficiency is the

greatest cause of preventable brain damage in childhood which is the primary motivation behind the current worldwide drive in its elimination (de Benoist *et al*. 2007).

The iron profile from the Maziya-Dixon *et al*., (2004) survey showed that almost 20 % of children were iron deficient and another 8 % had depleted iron stores with more than 25 % of children under five iron-deficient; the level of iron deficiency may have been due to poor dietary sources of iron, or sources in which the iron is in a form that is not available for absorption. Vegetables are a major source of iron subject to chelation by oxalates, phytates, and other anti-nutrients, making it unavailable for absorption by the body. Other nutrients enhance iron absorption—particularly vitamin C. Animal sources of iron are most desirable (Kuku *et al*., 2016).

In case of severely malnourished wasted children, serum total protein and albumin are expected to be normal or reduced (Jelliffe, 1989; Suskind, 1990). Serum albumin level is an important prognostic indicator as they are dependent on the rate of synthesis, the amount secreted from the liver cell, distribution in body fluids, and level of degradation. Hypoalbuminemia results from a derangement in one or more of these processes (Peralta *et al*., 2016). Low serum albumin levels are an important predictor of morbidity and mortality. A meta-analysis of cohort studies found that, with every 10 g/L decrease in serum albumin, mortality was increased by 137% and morbidity increased by 89%. Whether or not hypoalbuminemia is merely a marker of severe protein malnutrition, which itself is a cause of increased morbidity and mortality or an independent risk factor for death, is unclear (Peralta *et al*., 2016).

2.5 Pastoralism

Pastoralism, the use of extensive grazing in rangelands for livestock production, is one of the key production systems in the world's drylands; nonetheless, throughout much of its long history its reputation has been unflattering, its practitioners marginalised by sedentary cultivators and urban dwellers. Pastoral societies have risen and fallen, fragmented into isolated families or constructed world-spanning empires and their demise regularly announced, often in the face of entirely contrary evidence of their persistence (Roger, 2001). Pastoralists are strongly associated with rangelands across the world, the mobility of their animals makes it possible to exploit nutritional resources in regions unavailable to arable farmers; rangelands is a broader term than grasslands, including regions where woody vegetation is dominant; moreover, it is common in texts describing land from the viewpoint of livestock production (Roger, 2001).

2.5.1 Characteristics of pastoralists

Patoralists have to balance their knowledge of pasture, rainfall, disease, political insecurity and national boundaries with access to markets and infrastructure. They prefer established migration routes and often develop longstanding exchange arrangements with farmers to make use of crop residues or to bring trade goods. Pastoralists usually only diverge from their existing patterns in the face of a drought, a pasture failure or the spread of an epizootic. Nonetheless, this flexibility is often the key to their survival (RIM 1989).

Transhumance is the regular movement of herds between fixed points to exploit seasonal availability of pastures; there is strong association with higher-rainfall zones; if the precipitation is such that the presence of forage is not a problem, then herders can afford to develop permanent relations with particular sites, for example building houses (Blench,

2001). Horizontal transhumance is more opportunistic, with movement between fixed sites developing over a few years but often disrupted by climatic, economic or political change; transhumant pastoralists often have a permanent homestead and base at which the older members of the community remain throughout the year (Blench, 2001). Transhumance is often associated with the production of some crops, although primarily for herders' own use rather than for the market (Blench, 2001).

A characteristic feature of transhumance is herd-splitting; the men take away the majority of the animals in search of grazing, but leave the resident community with a nucleus of lactating females (Blench, 2001). Traditional pastoral production demands mobility, the *sine qua non* of dry land cattle keeping, as the main means of maintaining herd productivity. (Coughenour *et al.* 1985; Scoones 1994). There are many variations on this procedure and moreover the development of modern transport has meant that in recent times, households are not split up as radically; members can travel easily between the two bases whether it is milking females, weak animals or work animals that are left behind differs substantially between one system and another and may even vary within an individual system on a year-by-year basis. (Roger 2001)

Apart from their livestock, most pastoralists keep non-pastoral species, notably chickens and dogs (Nicolaisen and Nicolaisen, 1997). Usually these enterprises are rather casual and vary considerably from one fraction to another. However, in West Africa, the chickens carried by Fulbe nomads grow very fat on the worms associated with animal dung and thus constitute a significant source of cash to the household; a constant factor among pastoral populations is the assignation of milk and milking to women (Little 1994). Men usually only milk animals for their immediate consumption almost everywhere but women are assigned the right to milk

animals for feeding the family and for sale, where there are surpluses, this has been positive for women where the external market for milk has increased demand, for example in Sudan where the introduction of rural cheese factories pushed up prices (Michael, 1987).

West African cattle may give as little as one litre a day, compared with up to sixty in highly intensive stall-fed systems, the orientation of pastoralists towards the market has been extremely variable across the world, according to accessibility and ecology (Blench, 1996). Pastoralists have always had to exchange some products with outsiders for basic foodstuffs and minor household goods; extreme weather pastoralists have generally reduced this to minimum because of the difficulties of such trade. However, West African pastoralists seem to have coevolved with highly sophisticated long-distance trade networks, and indeed make use of them to pass information about both market conditions and forage resources (Blench, 1996).

Pastoral and agro-pastoral communities account for 20 million and 240 million individuals respectively in sub-Saharan Africa (Holden *et al*., 1997). Johnson (1969) identifies the combination of animals herded and the role that agriculture assumes in a pastoral group's economy as being the most influential factors determining migration. The first and most obvious response to drought is to move the animals to areas where there is still pasture and water; this is probably the major motor for the expansion of pastoralism, especially in the case of the eastward expansion of the Fulbe across the West African savannahs Johnson (1969). He further observed that if pastoralists face a long journey stock deaths increase, and they must weigh likely losses from the migration against comparable losses were they are to stay on suboptimal land.

2.5.2 Pastoral diets

Nomadic pastoral diets are typically protein-rich and calorie-poor based on three food groups: milk, meat products, and cereals acquired by trade or cultivation; meat products are rarely consumed, where animals are slaughtered for ritual occasions or social obligations, milk accounts for 30% of diets of Fulani (Sellen, 1996) and there is marked seasonal variation in consumption of these products, where milk is consumed mainly in the short wet seasons and people turn to cereals as pastoralists sell livestock (usually goats and sheep) to purchase maize meal, sugar, tea, and tobacco, which yield little more than immediate calories and stimulant to avoid hunger (Galvin and Little, 1999).

Milk is high in protein and micronutrients including vitamins A, C, and calcium. However, milk has low caloric value and accounts for only 10-25% of total calories consumed by individuals annually in nomadic communities (Galvin and Little, 1999). Reported caloric intake among pastoralists ranges from 1080 - 1350 kcal/day with daily calories increasing in wet season as milk replaces grains (Sellen, 1996). Wealth differences within livestock keeping pastoralist communities have little bearing on nutritional status, a fact attributed to a "moral economy" where wealthier households share milk and livestock with poorer relatives in nomadic communities (Fratkin, 2004). However, adult women show greater under-nutrition than adult men, a fact which may be due to higher energy expenditure associated with domestic labor and childbearing (Fujita *et al*., 2004), and differential consumption associated with male privilege (Fratkin, 2004).

The preferred food of all pastoral populations is milk and its products; cereal is the most important staple food, meat, game and fish are added to the diet at less regular intervals (Galvin and Little 1999). Animal products are important components of children's diet as

they provide high quality protein and are excellent sources of micronutrients (Davidson, 2002). Pastoral diets generally are characterized as high in protein but low in calories, with marked seasonal variation in both protein and energy content (Little *et al*., 1993). During dry periods as milk supplies diminish, small stocks are increasingly sold to purchase foods particularly grains (maize meal or *posho)* and other carbohydrates (sugar to mix with tea) (Galvin and Little, 1999). The milk-based, high-protein diet of pastoralists, nonetheless, appears to contribute positively to their adaptation to a highly seasonal environment with limited resources for dietary energy (Galvin and Little, 1999). The positive ramifications of a pastoralist high-protein diet may be particularly significant for infants, pregnant women, and lactating mothers, who are particularly at risk from poor environments (Panter-Brick, 1997).

A review of dietary composition for eight pastoral populations clearly showed that dietary differences among them were quantitative rather than qualitative (Galvin, 1992) Milk products and cereals are always the major components of the diet, the former to a more variable extent. The relative annual contributions of different foods to total diets vary substantially among populations (Galvin, 1992). Some populations also utilize wild foods (Becker, 1983) and others purchase goods such as tea, sugar and oils. (Galvin 1992).

Milk and milk products account for around 30% of the dietary energy of pastoral groups for Fulani (Gray 1994). Meat consumption is negligible in some groups (Tuareg, Fulani, and Masaai) and is never as important as early reports suggested accounting for less than 10% of total calories in more than half the populations studied (Swift *et al*., 1990).

Unsurprisingly virtually all African pastoralists studied suffer reduced dietary intakes during dry seasons; this might be attributed to lowered milk yields when animals are out of condition

and indeed all groups studied have significantly lower dietary contributions from milk in the dry seasons versus the wet season however, given the involvement of all pastoral populations in cultivating or trading cereals, it is really due to a failure to substitute purchased cereals sufficient to replace lost household milk production during dry periods and droughts (Sellen, 1996).

The underlying reasons for this have not been properly examined. They almost certainly involve unfavourable terms of trade during dry season conditions (higher grain prices, lower market demand for livestock and poorer conditions (higher grain prices, lower market demand for livestock and poorer condition of sale animals) as well as logistic difficulties in transporting livestock and grain between remote dry season camps and market centres (Sellen, 1996).

2.5.3 Nutritional status of pastoral populations

Anthropometric data indicate that seasonal effects on body size and composition may be weaker than might be expected; a large proportion of the children and most of the adults in African pastoralist populations fall below anthropometric reference data on weight and weight for height. This strongly suggests that the generally low food intakes reported for African pastoralists do play a significant role in producing growth deficits which persists into adulthood. However more data is needed before a firm conclusion that scarcity of food contributes to reduced growth among pastoralists (Sellen, 1996).

Specific mechanisms for the etiology of under-nutrition remain unclear. More data on dietary quality and more longitudinal observational studies of child growth and its relation to a variety of possible causal factors are needed; there is evidence that low energy and protein

intakes may not be the prime cause of growth faltering and marginal under-nutrition in all populations (Sellen, 1996). The importance of infection in the etiology of under-nutrition and seasonal fluctuations in nutritional status remains poorly evaluated despite very early interest by human biologists; disease ecology and socio-economic disadvantages will interact with diet to produce under-nutrition (Sellen, 1996).

Health problems among pastoral populations include high rates of malaria, STDs, accidents; contagion from livestock including anthrax, trachoma, brucellosis, tuberculosis; reduced risks of 'settled' diseases including measles, cholera, worm loads; and poor access to health clinics, medicines, and vaccinations (Sheik-Mohamed and Velema, 1999). Typically, there are contrasting seasonal patterns of nutritional stress between agriculturists and pastoralists. Critical periods for agriculturists coincide with the food shortage and high labour demand associated with farming and harvesting during the pre-harvesting time (Simondon *et al*., 1993).

The ability of pastoralists to fulfil their role as food producers is directly dependent on the viability of their livelihoods and the factors affecting their livelihood strategies (Rass, 2006). The livelihoods of pastoral people depend on three things: first, access to assets such as land, livestock, pasture, water, animal health services, community networks, markets, credit and education; second, the environment in which these assets are combined for production and consumption, specifically the political, organisational and institutional infrastructure within which they operate, which affects their ability to use these assets to achieve positive livelihood outcomes; and third, the dynamic context of risks and seasonal and continuous trends that affect assets and their environment and determine the vulnerability of livelihoods (Rass, 2006).

2.6 The Fulani people

2.6.1 General characteristics

There are 120 million pastoralists worldwide, 50 million of these in sub-Saharan Africa where they constitute 12% of the rural population (Rass, 2006). The Fulani are the primary pastoral group in Nigeria with a population of approximately 15.3 million (Blench, 2004). Today, one finds both nomadic, pastoral Fulani (mbororo'en) and settled Fulani (Fulbewuro) all over Africa and beyond (Blench, 2004). The pastoral Fulani (full-time cattle keepers) move about with their cattle for much of the year; they live temporarily in the makeshift structures until they migrate again in search of a new base that is proximal to good grazing land, sometimes the movement is necessitated by clashes with farmers over farm trespass and destruction of farm produce; these clashes are common and recurring cases which have been adduced to economic reasons rather than religious, cultural or political (Abbass, 2012).

In Nigeria, they are the mainstay of the meat and milk industry, accounting for about 90% of cattle herd ownership, which makes up 3.2% of the GDP (Abass, 2012). They rear different species of cattle, such as the *Keteku*, *Muturu*, and *Kuri*, but the *Zebu* is identified as the most common (Iro 1994). They also supply skins, bones, and horns as complementary products; the pastoralist system involves young men who tend the herd while the women cook and sell animal products in the market. The elders, in their own stead, are in charge of developing and managing resources at the levels of the community and domestic units (Iro, 1994).

Describing the annual herding cycle of the Fulani, Iro (1994) stated that the herding season begins with southward movement of the herd and along stream valleys from October to December marking the end of rainy season and beginning of dry season. January to February is the harmattan season that is characterized by longer grazing hours, herd splitting, and more

frequent visits to stable water sources. These thus increase southward movement of the herds. The months of March and April are usually the toughest for the herdsman and his cattle, as it is the hottest period in the grazing calendar. Indeed, he now herds his cattle only in the evenings and nights (Iro, 1994). May and June signify the end of dry season and vegetation begins to appear. This also marks the beginning of northward movement of cattle herds. From this period up till September is the peak of rainy season

The Fulani pastoralists drift from one gazing land to another as the climate permits; these Fulani who can be found in the regions of West Africa, e.g. Nigeria, are nomads with aquiline stature, bordering on the lean side (Louis, 2014). In the course of the five of six months journey, temporal camps are established usually near a pagan village; provisional shelters are built by the women from a frame of bamboo or other lightweight wood that is carried on the back of one of the bulls, together with some kitchen utensils (Lambrecht, 1976). Arriving at a suitable campsite, the frame is set up covered with grasses or leaves except for a small door opening on the west side, where the herd is traditionally kept in a fallow field with waste vegetation from the last harvest; the occupation of such pasture is usually with the assent of the owner who values the manure that accumulates on his field and who sometimes pays with money or barter for the privilege of keeping the cattle on his land (Lambrecht, 1976).

While in camp, the Fulani women are responsible for the milking of the cows and for the processing of various dairy products; profits from the sale of these products at the local market are used by the women to run the household (Lambrecht, 1976). The pastoralists other occupational side-line consist of a few crafts like rope making and calabash carving; their mobile nature account for why they do not have an elaborate material culture, believing

that heavy possessions need a permanent home and they are more concerned with the training of the cow herd, their language and tradition and above all their cattle (Louis, 2014).

In a study on Pastoral livelihoods of the Fulani on the Jos Plateau of Nigeria by Majedokunmi (2014). Livestock sale was the most important source of cash income amongst households, accounting for 52% of pastoral income, ahead of crops (22%) and milk (12%). In terms of individual household income diversity, 30% of households relied on livestock as their sole source of income. Forty percent supplemented the income from livestock with crops and 15% with milk. Fifteen percent gained additional income from off-farm activities, mostly mining and sale of firewood. The results of wealth grouping by livestock holdings show that few herders are in the poor (6.1%) group while the majority are in the middle (50%) and better off groups (43.9%) on the Jos Plateau (FEWS, 2004).

2.7 Migration

Identifying who is a migrant can be difficult due to the dynamic nature of migration, which in turn implies defining and assessing temporal and spatial criteria. A short-term migrant is defined as a person moving to a country other than that of his or her usual residence for a period of at least 3 months but less than a year (12 months), and often is the status of a person who moves from one region to another in accordance with seasons (UN, 1998). In terms of space patterns, migration can imply movement within a country (internal migration, particularly between rural and urban areas), or movement transnationally if migrants "forge and sustain multi-stranded relations that link together their societies of origin and settlement" (Schiller *et al.*, 1992).

2.7.1 Effects of seasonal migration on children

Nutrition and migration describe the essence of a child's health status and the degree of their social protection. They are determinants of a child's survival, physical, cognitive and social development and of the foundations for realizing their potential (UNICEF, 2014). Research has found significant seasonal variation in weight-for-age (Abdallah *et al.*, 1985), weight-for-height (Hassan *et al.*, 1985), growth velocity (Branca *et al.*, 1993), clinical diagnoses of malnutrition (Trowbridge *et al.*, 1982), and iron status (Hassan *et al.*, 1985).

Fluctuations in height-for-age have been less consistently demonstrated (Branca *et al.*, 1993), probably because this indicator is less likely to be affected by short, cyclical changes in nutritional status. Typically children's nutritional status, as measured by weight-for-height or weight-for-age, is worst during the rainy season or prior to harvest and best during the months following harvest. The magnitude of seasonal fluctuation tends to be smaller in regions with bimodal rainy seasons (Schofield, 1974) and agricultural systems that include multiple harvests over the course of the year (Teokul *et al.*, 1986).

Season may also have a greater impact on children in poorer households (Schofield, 1974). Researchers typically suggest three main pathways through which season has this effect on nutritional status: an increase in morbidity during the rainy season (Schofield *et al.*, 1974), decrease in food availability during the pre-harvest season (Branca *et al.*, 1993) and fluctuating demand for female labour and its impacts on caring practices (Abdullah *et al.*, 1985). In rural areas, illness has been identified as a primary link between season and nutrition (Marin *et al.*, 1996). Dietary diversity and household income have also been suggested (Garrett and Ruel, 1999).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Materials

3.1.1 Study Area

Kajuru Local Government Area is located on Longitude 9° 59'N and 10° 55'N and Latitude 7° 34'E and 8° 13'E with an area of 2,464 km^2.The study area is sub-divided into 10 wards to reflect namely:- Kufana, Maro, Idon, Kallah, Kasuwan Magani, Kajuru, Buda, Rimau, Afogo and Tantatu.

The climate of Kaduna state is the tropical dry-and-wet type, the wet season lasts from April through mid-October with a peak in August, while the dry season extends from mid-October of one calendar-year to April of the next (Abaje *et al*, 2010). The annual average rainfall in the state is about 1323mm. The spatial and temporal distribution of the rain varies, decreasing from an average of about 1733mm in Kafanchan-Kagoro areas (around study area) to about 1203mm in the central part (Kaduna city) and about 1032mm in Zaria, lkara and Makarfi LGAs in the north.

Kajuru local government area has an estimated population of 110,868 people (National Population Commission Census, 2006). The major ethnic group is *Adara*, others include *Hausa, Fulani, Gbagyi, Yoruba, Igbo* and *Jaba.*

Figure 3.1.1: Map of Kaduna State (Source: www.kadunastate.gov.ng)

3.1.2 Study Population

The study population comprised primarily of semi-settled Pastoralist Fulani in *Kajuru* Local Government Area of Kaduna State who migrated from other parts of the Country to settle at particular times across the various districts of Kajuru Local Government Area. These Fulani households settle temporarily for a few years in same location but migrate yearly with their livestock towards pasture but leave behind young children and aged or elderly members of the household.

3.1.3 Inclusion Criteria

All transhumant Pastoralist Fulani households semi-settled in Kajuru Local Government Area who volunteered.

3.1.4 Exclusion Criteria

Permanently settled Fulani households and Fulani who are mixed with other ethnic groups in *Kajuru* Local Government Area.

3.1.5 Informed consent

Prior to implementation, extensive consultation was done with the community leaders *Ardo.* Informed consent was sought from the Chairman Miyetti Allah Cattle Breeders Association of Nigeria, Kaduna and also from parents/ guardians using standard protocol (*Appendix VI*)

3.1.6 Ethical approval

Ethical approval was obtained from the Ministry of Health, Kaduna State (*see appendix xi),* in accordance with the Helsinki declaration in 2000. This is a code of ethics on human experimentation drafted by the World Medical Association in 1964.

3.1.7 Sampling Technique

A purposive sampling technique was used to select the Local Government Area due to the nature of the study subjects. The lists of all settlements of Fulani Pastoralist with their population within the Local Government were obtained through the Primary Health Clinic at Kajuru. A list of the settlements and population were fed into the ENA (2011) software for generation of clusters. In the selected clusters, households were selected by Simple Random Sampling using hat method after an exhaustive household listing exercise. All children between 6-59months in the selected households were enlisted for the first part of the study. A systematic random sampling was used to select children (6-59 months) to be tracked from the already measured subjects.

3.1.8 Sample Size Calculation

The sample size for this study was obtained using the formula: $[n = z^2pq/d^2]$

Where:

n= the desired sample size

z= the standard normal deviation, usually set at 1.96

p= the proportion in the target population having the particular trait or prevalence (the prevalence of micronutrient deficiency in Kaduna State is 0.41%).

q= 1.0-p

d= degree of accuracy desired, usually set at 0.05

Therefore, $n= (1.96)^2(0.41)\ (0.59)/\ (0.05)^2 = 371$ (Thrusfield, 2005).

Sampling Design Effect=1.5 Therefore n x 1.5 = 556

Then addition of 5% of Total due to non-response 5% of 461=23 and 23+461= 584.

3.1.9 Study Design

This was a cohorts study directed towards investigating the influence of seasonal migration on the nutritional status of Pastoralist Fulani in Kajuru local Government area of Kaduna State.

3.2 Methods

3.2.1 Collection of Blood Sample

Blood was collected using venepuncture with the aid of a sterile syringe by a skilled phlebotomist. About 5ml of blood was collected from peripheral vein and placed in a sample bottle containing no anticoagulant and allowed for about 30-60 minutes for spontaneous blood clotting. Serum was separated and preserved for analysis of serum iron, zinc and Albumin.

3.2.2 Measurement of weight and height

Height and weight of the Pastoralist Children (6-59months) were determined according to standard anthropometric methods (WHO, 2008). Height was measured to the nearest 0.1 centimetres (cm) on bare feet with subject standing upright against a mounted stadiometer. Weight was measured to the nearest 0.1 kilogramme (kg) with participants lightly dressed using a UNICEF SECA scale. Values obtained were used to determine weight for height, weight for age and height for age which were compared to the WHO (2006) Multicentre Growth Reference Standards to assess the level of malnutrition.

3.2.3 Measurement of mid upper arm circumference (MUAC)

The MUAC of Pastoralist Fulani Children (6-59months) was measured using a three-coloured special tape with the red (11.5mm) indicating severe acute malnutrition, yellow

(11.5-<12.5mm) indicating moderate acute malnutrition and the green (12.5mm and above) indicating normal nutritional status. (UNICEF, 2009) Measurement of each subject was done according to the procedures outlined by UNICEF for measuring MUAC.

3.2.4 Dietary intake records

This was assessed using food frequency methodologies where respondents report their usual frequency of consumption of each food from a list of foods for a specific period. Information was collected on frequency, but little detail was collected on other characteristics of the foods as eaten, such as the methods of cooking (Zulkifli, 1992). (*See annex II and III)*.

3.2.5 Determination of haemoglobin concentration

The subject's finger pulp was cleaned with methylated spirit and then pricked using a needle. The initial blood was cleaned and the finger squeezed gently to get a drop of blood. The blood was inserted into the hemocue Hb 201+ automated machine system (HemoCue AB Angelholm Sweden). After 30-45 seconds the haemoglobin result was displayed in g/dl (HemoCue® Operating Manual. Ångelholm, Sweden).

3.2.6. Estimation of Serum Iron using Tietz et al., (1995).

3.2.5.1 Principle

The iron was dissociated from transferrin-iron complex in weak acid medium. Liberated iron was reduced into the bivalent form by means of ascorbic acid. Ferrous ions gave a coloured complex with FerroZine. The intensity of the colour formed was proportional to the iron concentration in the sample.

3.2.5.2 Procedure

Three sets of clean dry test tubes were arranged accordingly in the test tube rack. These included Tube for the sample, blank and standard into each of the tubes. 1000_ul of working reagent was dispensed including blank and standard tube. 200_ul of each sample was pipette and dispensed into corresponding labeled tube while blank tube contained 200_ul of water. Each content was mixed and incubated at 37^0C for 5 minutes. Absorbance of each sample, blank and standard were taken at 562nm wavelength.

3.2.5.3 Calculation

Iron (µg/dL) = (A) Sample – (A) Sample Blank X 100 (Standard Concentration)
(A) Standard

Conversion factor: µg/dL x 0.179= µmol/L.

3.2.7 Estimation of serum zinc using Colometric method by Johnsen and Eliasson (1987)

3.2.6.1 Principle

Zinc formed a red chelate complex with 2-(5-Brom-2-pyridylazo)-5-(N-propyl-N-sulfo-propylamino)-phenol. The increase in absorbance was measured. The absorbance is usually proportional to the concentration of total zinc in the sample.

3.2.6.2 Procedure

Three sets of clean dry test tubes were arranged accordingly in the test tube rack; these included tubes for test sample, blank and standard. 1000_ul of working reagent was dispensed including blank and standard tube. 50_ul of each sample was dispensed into corresponding labeled tube while blank tube contained working reagent only. Each content was mixed and incubated at 37^0C for 5 minutes. Absorbance of each sample, blank and standard were taken at 560nm wavelength.

3.2.6.3 Calculation

Absorbance of the sample = A_S and Standard = A_{STD}.
Zinc (µmol/l) = A_S / A_{STD} x 30,6

3.2.8 Estimation of serum albumin

3.2.7.1 Principle

This was done using the Bromocresol green (BCG) method described by Doumas, (1971)

Albumin was bound by the BCG dye to produce an increase in the blue-green colour measured at 630 nm. The colour increase was proportional to the concentration of albumin present.

3.2.7.2 Procedure

Three sets of clean dry test tubes were arranged accordingly in the test tube rack. These included Tube for the sample, blank and standard into each of the tubes. 1000_ul of working reagent was dispensed including blank and standard tube. 50_ul of each sample was pipette and dispensed into corresponding labeled tube while blank tube contained working reagent only. Each content was mixed and incubated at room temperature for 5 minutes. Absorbance of each sample, blank and standard were taken at 630nm wavelength.

3.2.7.3 Calculation

$$\text{Albumin (g/dL)} = \frac{\text{(A) Sample}}{\text{(A) Standard}} \times 5 \text{ (Standard concentration)} =$$

In the sample Conversion factor: g/dl X 144.9 = µmol/L

3.2.9 Statistical Analysis

Anthropometry data was analyzed using ENA for Smart Software (2011). Biochemical data were expressed as mean ± Standard deviation; Socio-demographic data and Dietary Intake Records were presented using Descriptive statistics such as mean, frequencies, standard deviation, and percentages. Student's t-test was used to compare nutritional status indices before and after seasonal migration. P-values less than 0.05 were considered significant.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic Characteristics of Respondents

A total of 581 children aged 6-59months were considered from 72 Settlements (*Ruga*) which were chosen from five wards with the highest number of children (i.e. *Tantatu* (41.6%), *Kajuru(*12.2%), *Kallah (*13.6%), *Iburu(*12.5%) and *Budah* (20%) districts) containing 279 households of which 303 (52.2%) were boys and 278 (47.8%) were girls. In 54% of settlements, the number of persons were above 20persons with only 8% of settlements having between 1-9 persons; family size was mostly (61%) between 6-9 members per household and 6% of households had above 10 members.

In all households visited, the household head was a male and the religion being practiced among all households was Islam with an average of one wife each, but in *Kajuru* and *Kallah* districts the average number of wives was two. The only form of formal education the household heads had was adult education with *Kajuru* having the highest percentage (50%) followed by *Kallah* (20%) and *Budah* having the lowest (1%).

The age distribution of the household head was depicted in Table 4.1. The age range of 40-49 years had the highest (22%) percentage; the age groupings of 30-39years, 50-59 years, 60-69years, 20-29years and above 70 years were 19%, 18%, 16%, 14% and 11% respectively.

The distribution of mothers' age showed that the age range of 10-19years had the highest (39%) percentage with about 11% between 40-49 years and 20-29years at 27%. The mother's educational status showed that, those with no formal education had the highest percentage of 98.5%. (Table 4.1)

The majority of the study population attended primary school (68%) and only 2% attended secondary school while the rest had no access to schools within their vicinity. At the time of the survey, caregivers were available in 98% of the households while the comparable percentage among fathers was 40%. The percentage of families where father and mother lived separately was 2% only. The age distribution of children in months showed that the age range of 37-59months had the highest (39%) percentage followed by 25-36months (22%) and 13-24 months (20%) while 6-12months was the least at 19%.

Table 4.1.1 shows that there was no source of electricity in all the houses visited and all the households used lantern or battery powered torchlight to light their homes. In majority of the households, the main source of drinking water were unprotected wells while only a small percentage had access to a clean stream and borehole. Of all the houses, about 60% had walls made of clay; the percentage of houses that used leaves as walls was 29% and 4% used cemented blocks. A total of 65% of the houses had roofing made with stalks; another 24% had roofs made up of corrugated iron sheets while 11% used leaves. Of all the houses, 76% had clay floors while 17% had cement for flooring and only 7% had floor with sand. Almost all the households (94.4%) used undesignated open area for defecation while only 5.6% of households used pit hole latrines.

4.2 Socio-economic Activities of Households

The Primary occupation of the household head as shown in Table 4.2 is Pastoralism (90%) followed by Farming (7.50%). About 21% of the mothers were engaged in farming; the others hawked milk (31%) while majority had no employment (42%). The main source of income among the study population was sale of livestock, crops and their products.

Table 4.1: Socio-demographic Characteristics of the Respondents n=279

Variable	Frequency	%age (%)
Household Heads (Age Range)		
20-29	44	15.77
30-39	52	18.64
40-49	63	22.58
50-59	50	17.92
60-69	40	14.34
70 above	30	10.75
Mother (Age Range)		
10-19	109	39.07
20-29	76	27.24
30 – 39	65	23.30
40-49	29	10.39
Mother's Educational Status		
No formal Education	275	98.5
Primary/Adult Education	4	1.5
Number of Persons per settlement		
1-9	6	8.33
10-19	27	37.5
20 above	39	54.17
Family size		
2-5	93	33.33
6-9	170	60.93
10 above	16	5.73
Children age (months)		
6-12	113	19.4
13-24	116	20.0
25-36	125	21.5
37-59	227	39.1
Total	**581**	**100**

Table 4.1.1: Types of houses and household facilities available to households

Item	Frequency	Percentage (%)
Source of Cooking		
Firewood	279	100
Source of Energy		
Electricity	-	-
Others	279	100
House type		
Walls		
Clay	186	66.66
Leaves	81	29.03
Block wall	12	4.30
Roof		
Stalks	182	65.23
Corrugated iron sheet	66	23.66
Leaves	31	11.11
Floor		
Clay	213	76.34
Sand	19	6.81
Cemented	47	16.85
Source of Water		
Deep well (Unprotected)	217	77.78
River/Stream	58	20.79
Borehole	4	1.43
Type of Toilet		
Pit latrine	16	5.73
Open defecation (bush)	263	94.27
Assets		
Motorcycle	270	96.77
Radio	272	97.49
Mobile phone	277	99.28
Mosquito Nets	70	25.09

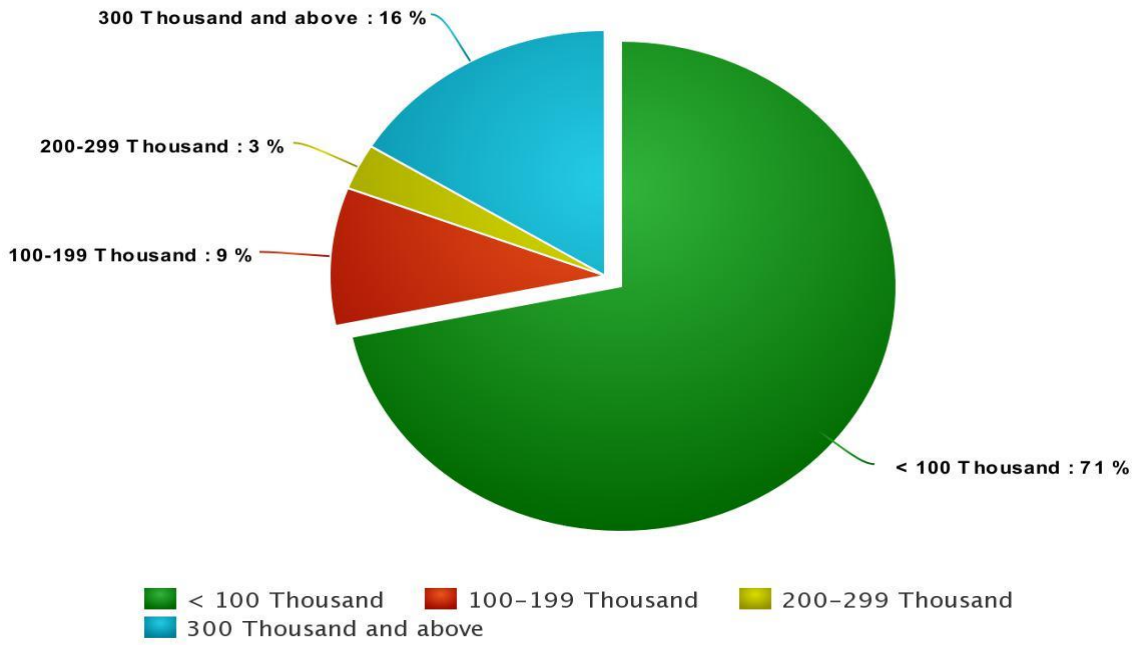

Figure 4.1: Percentage Distribution of Estimated Annual Income of Households (Naira)

Table 4.2: Socio-economic activities of Households

Variable	Classification	Percentage (%)
Primary Occupation of Household	Pastoralism	90.50
Head	farming	7.50
	*Salaried employment	0.90
	Hunting	1.10
Mother's Occupation	Subsistence farming	21.11
	Weaving	20.06
	Broom making	10.99
	Hawking of *fura/nono*	5.61
	Unemployed/Housewives	42.23

* Salaried employment means some of the household heads are employed by the Primary Health Care clinic in Kajuru LGA to help locate settlements during immunization & other health campaigns

4.3 Anthropometric Characteristics of Pastoralist Fulani Children (6-59 months)

The distribution of children is shown in the Table 4.3; boys slightly dominated but overall the ratio was 1:1 and 1:0 for dry and wet seasons respectively.

4.4 Prevalence of Wasting in Fulani Children (6-59months)

The prevalence of Global Acute Malnutrition was **14.5%** (10.0 - 20.5; 95% C.I.) and Severe Acute Malnutrition was at **2.8%** (1.1 - 6.9; 95% C.I.) Global Acute Malnutrition (GAM) is defined as W/H < -2 ZS and/or nutritional oedema while Severe Acute Malnutrition (SAM) is defined as W/H < -3ZS and/or nutritional oedema. The prevalence of severe acute malnutrition was highest in children aged 6-12months and lowest in children aged 37-59 months and also boys showed higher prevalences in both indicators than girls.

Figures 4.2 and 4.3 show the weight for height distribution curves of the survey samples in Z-scores for comparison with the WHO reference population during the dry season and wet season respectively. The weight for height distribution curve during the dry season of the sample is shifted to the left, which indicates a suboptimal nutrition status compared to the reference population (WHO reference Table).

Table 4.3*:* Distribution of Age and Sex of Pastoralist Fulani Children (6-59mths)

Age (months)	Season	Boys No.	Boys %	Girls No.	Girls %	Total No.	Total %	Ratio Boy:Girl
6-12	Dry Season	59	52.2	54	47.8	113	19.4	11:10
	Wet Season	2	66.7	1	33.3	3	2.1	2:1
13-24	Dry Season	55	47.4	61	52.6	116	20.0	9:10
	Wet Season	25	59.5	17	40.5	42	29.0	15:10
25-36	Dry Season	57	45.6	68	54.4	125	21.5	8:10
	Wet Season	12	34.3	23	65.7	35	24.1	5:10
37-59	Dry Season	132	58.1	95	41.9	227	39.1	14:10
	Wet Season	34	52.3	31	47.7	65	44.8	11:10
Total	Dry Season	303	52.2	278	47.8	581	100.0	11:10
	Wet Season	73	50.3	72	49.7	145	100.0	1:1

Table 4.4: Prevalence of Acute Malnutrition based on weight-for-height z-scores (and/or oedema) and by sex

		All n = 581	Boys n = 303	Girls n = 278
Prevalence of global acute malnutrition	**Dry Season**	**14.5 % (n=84)** (10.0 - 20.5;; 95% C.I.)	**13.5 % (n=41)** (11.3 - 16.1;; 95% C.I.)	**15.5 % (n=43)** (8.8 - 25.8;95% C.I.)
	Wet Season	**4.8 % (n=7)** (2.4 - 9.6;; 95% C.I.)	**4.1 % (n=3)** (1.4 - 11.4;; 95% C.I.)	**5.6 % (n=4)** (2.2 - 13.4;; 95% C.I.)
Prevalence of severe acute malnutrition	**Dry Season**	**2.8% (n=16)** (1.1 - 6.9;; 95% C.I.)	**3.0 % (n=9)** (1.2 - 7.4;; 95% C.I.)	**2.5 % (n=7)** (1.0 - 6.5;; 95% C.I.)
	Wet Season	**1.4 % (n=2)** (0.4 - 4.9; 95% C.I.)	**1.4 % (n=1)** (0.2 - 7.4; 95% C.I.)	**1.4 % (n=1)** (0.2 - 7.5; 95% C.I.)

The prevalence of oedema is 0.0 %

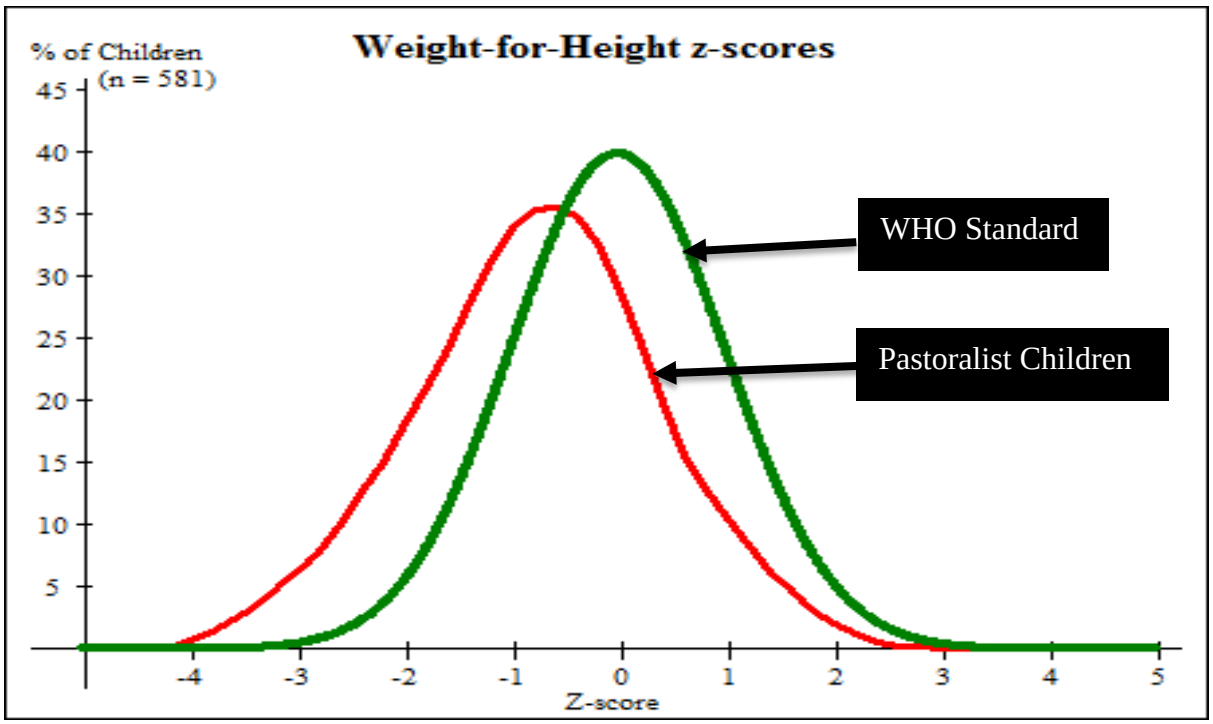

Figure 4.2*:* Comparison of the distribution of z-score for weight-for-height of pastoralist under-five children to WHO child growth standards (Dry season)

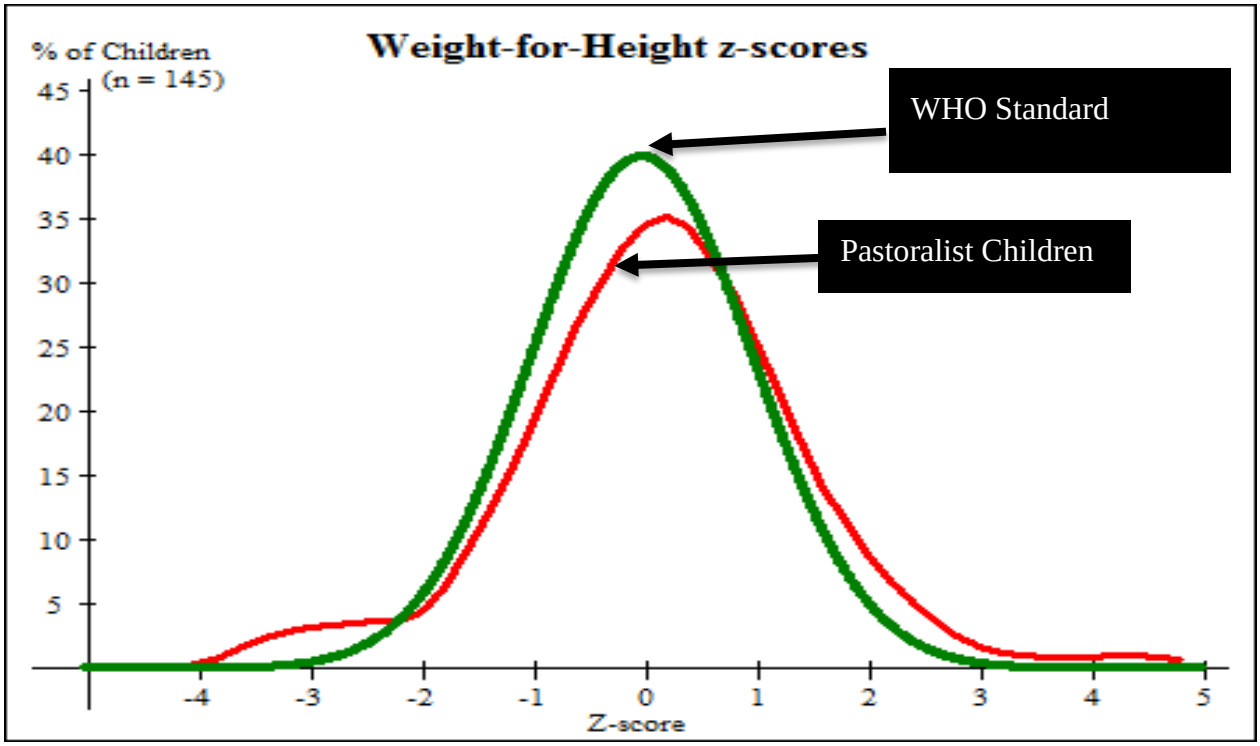

Figure 4.3*:* Comparison of the distribution of z-score for weight-for-height of pastoralist under-five children to WHO child growth standards (Wet Season)

Table 4.4.1: Prevalence of acute malnutrition by age, based on weight-for-height z-scores and/or oedema

			Severe wasting (<-3 z-score)		Moderate wasting		Normal (> = -2 z score)		Oedema	
Age (months)		**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-12	**D.S.**	113	5	4.4	18	15.9	90	79.6	0	0.0
	W.S.	3	0	0.0	0	0.0	3	100.0	0	0.0
13-24	**D.S.**	116	4	3.4	11	9.5	101	87.1	0	0.0
	W.S.	42	1	2.4	1	2.4	40	95.2	0	0.0
25-36	**D.S.**	125	1	0.8	8	6.4	116	92.8	0	0.0
	W.S.	35	1	2.9	1	2.9	33	94.3	0	0.0
37-59	**D.S.**	227	6	2.6	31	13.7	190	83.7	0	0.0
	W.S.	65	3	0.0	0	4.6	62	95.4	0	0.0
Total	**D.S.**	581	16	2.8	68	11.7	497	85.5	0	0.0
	W.S	145	5	1.4	2	3.4	138	95.2	0	0.0

D.S.-Dry Season, W.S.-Wet Season

4.5 Prevalence of Acute Malnutrition based on MUAC Cut-offs

Global malnutrition was defined as MUAC of less than 125mm and severe malnutrition was MUAC measurements below 115mm. Table 4.5 shows the prevalence of GAM at 6.2% during the dry season and 2.8% at wet season. During the wet season, there was no case of severe malnutrition among Fulani children (6-59months) but Girls were more moderately and severely malnourished than boys based on MUAC cut-offs.

4.6 Prevalence of Underweight among Fulani children (6-59months)

The prevalence of underweight was high (20.3%) during the dry season especially among boys (21.1%) but girls were more severely underweight (6.8%) than boys as shown in Table 4.6.

4.7 Prevalence of Stunting among Fulani children (6-59months)

Table 4.7 showed that Stunting levels were high during the wet season(37.2) compared to the dry season (23.4%); boys were more stunted than girls in both seasons including severe stunting which was 23.3% for boys in the wet season as compared to girls (8.3%).

4.8 Dietary Pattern of Pastoralist Households in Kajuru LGA

An un-quantified Food frequency Questionnaire (FFQ) was used to collect dietary information from the subjects. The frequency of eating different categories of food was arranged in three groups (Once daily, 1 to 6 times a week and occasionally). Tables 4.8 and 4.9 show the dietary pattern for dry and wet season of 279 and 72 households respectively in the five surveyed districts of *Kajuru* LGA, Kaduna. The most foods consumed both during wet and dry season were cereals and vegetables.

Table 4.5*:* Prevalence of acute malnutrition based on MUAC cut offs and by sex

		All n = 581	**Boys** n = 303	**Girls** n = 278
Prevalence of global acute malnutrition (< 125 mm)	**Dry Season**	**6.2 % (n=36)** (4.0 - 9.5; 95% C.I.)	**4.6 % (n=14)** (3.0 - 7.2; 95% C.I.)	**7.9 % (n=22)** (4.5 - 13.7; 95% C.I.)
	Wet Season	**2.8 % (n=4)** (1.1 - 6.9; 95% C.I.)	**1.4 % (n=1)** (0.2 - 7.4; 95% C.I.)	**4.2 % (n=3)** (1.4 - 11.5; 95% C.I.)
Prevalence of severe acute malnutrition (< 115 mm)	**Dry Season**	**1.4 % (n=8)** (0.5 - 4.0; 95% C.I.)	**1.0 % (n=3)** (0.3 - 3.0; 95% C.I.)	**1.8 % (n=5)** (0.5 - 6.5; 95% C.I.)
	Wet Season	**0.0 % (n=0)** (0.0 - 2.6; 95% C.I.)	**0.0 % (n=0)** (0.0 - 5.0; 95% C.I.)	**0.0 % (n=0)** (0.0 - 5.1; 95% C.I.)

Table 4.5.1: Prevalence of acute malnutrition by age, based on MUAC cut off's

			Severe wasting		Moderate wasting		Normal		Oedema	
Age (months)		**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-12	**D.S.**	113	4	3.5	17	15.0	92	81.4	0	0.0
	W.S.	3	0	0.0	0	0.0	3	100.0	0	0.0
13-24	**D.S.**	116	4	3.4	6	5.2	106	91.4	0	0.0
	W.S.	42	0	0.0	2	4.8	40	95.2	0	0.0
25-36	**D.S.**	125	0	0.0	4	3.2	121	96.8	0	0.0
	W.S.	35	0	0.0	2	5.7	33	94.3	0	0.0
37-59	**D.S.**	227	0	0.0	1	0.4	226	99.6	0	0.0
	W.S.	65	0	0.0	0	0.0	65	100.0	0	0.0
Total	**D.S.**	581	8	1.4	28	4.8	545	93.8	0	0.0
	W.S.	145	0	0.0	4	2.8	141	97.2	0	0.0

D.S.-Dry Season, W.S. - Wet Season

Table 4.6: Prevalence of underweight based on weight-for-age z-scores by sex

		All n = 581	**Boys** n = 303	**Girls** n = 278
Prevalence of moderate underweight (<-2 z-score)	**Dry Season**	**20.3 %** **(n=118)** (11.6 - 33.1;; 95% C.I.)	**21.1 %** **(n=64)** (11.0 - 36.6;; 95% C.I.)	**19.4 %** **(n=54)** (12.1 - 29.8;; 95% C.I.)
	Wet Season	**13.1 %** **(n=19)** (8.6 - 19.6; 95% C.I.)	**17.8 %** **(n=13)** (10.7 - 28.1; 95% C.I.)	**8.3 %** **(n=6)** (3.9 - 17.0; 95% C.I.)
Prevalence of severe underweight (<-3 z-score)	**Dry Season**	**5.0 %** **(n=29)** (2.2 - 11.1;; 95% C.I.)	**3.3 %** **(n=10)** (1.2 - 8.7;; 95% C.I.)	**6.8 %** **(n=19)** (3.3 - 13.8;; 95% C.I.)
	Wet Season	**3.4 %** **(n=5)** (1.5 - 7.8;; 95% C.I.)	**5.5 %** **(n=4)** (2.2 - 13.3;; 95% C.I.)	**1.4 %** **(n=1)** (0.2 - 7.5;; 95% C.I.)

.

Table 4.7: Prevalence of stunting based on height-for-age z-scores and by sex

		All n = 581	**Boys** n = 303	**Girls** n = 278
Prevalence of moderate stunting (<-2 z-score)	**Dry Season**	**23.4 % (n=136)** (12.8 - 39.0;; 95% C.I.)	**28.1 % (n=85)** (12.6 - 51.3;; 95% C.I.)	**18.3 % (n=51)** (11.4 - 28.2;; 95% C.I.)
	Wet Season	**37.2 % (n=54)** (29.8 - 45.3; 95% C.I.)	**49.3 % (n=36)** (38.2 - 60.5; 95% C.I.)	**25.0 % (n=18)** (16.4 - 36.1; 95% C.I.)
Prevalence of severe stunting (<-3 z-score)	**Dry Season**	**10.2 % (n=59)** (5.2 - 19.0; 95% C.I.)	**12.5 % (n=38)** (5.4 - 26.6; 95% C.I.)	**7.6 % (n=21)** (4.5 - 12.4; 95% C.I.)
	Wet Season	**15.9 % (n=23)** (10.8 - 22.7; 95% C.I.)	**23.3 % (n=17)** (15.1 - 34.2; 95% C.I.)	**8.3 % (n=6)** (3.9 - 17.0; 95% C.I.)

Table 4.8: Frequency of Foods consumed by Pastoralist Households during dry season in *Kajuru* LGA

Food Type	Frequency of Intake n =279						
	Frequency						Percent
Dairy	Kallah	Tantatu	Kajuru	Iburu	Budah	Total	
Once Daily	9	12	7	5	6	39	13.61
1-6 times a week	7	14	10	4	11	46	16.49
Occasionally	22	90	17	26	39	194	69.53
Meat							
Once Daily	1	2	3	-	-	6	2.15
1-6 times a week	6	16	9	3	4	38	13.62
Occasionally	31	98	22	32	52	235	84.23
Eggs							
Once Daily	-	-	-	-	-	-	-
1-6 times a week	5	5	6	3	7	26	12.90
Occasionally	33	111	28	32	49	253	87.10
Legumes							
Once Daily	2	18	13	5	7	45	16.13
1-6 times a week	5	26	11	9	24	75	26.88
Occasionally	31	72	10	21	25	159	73.12
Cereals							
Once Daily	36	116	31	35	56	274	98.20
1-6 times a week	2	-	3	-	-	5	1.79
Occasionally	-	-	-	-	-	-	-
Tubers							
Once Daily	12	25	4	9	7	57	20.43
1-6 times a week	16	81	27	22	42	188	67.38
Occasionally	10	10	3	4	7	34	12.19
Fruits							
Once Daily	4	13	8	2	3	30	10.75
1-6 times a week	20	42	15	6	7	90	32.26
Occasionally	14	61	11	27	46	159	56.99
Vegetables							
Once Daily	24	111	29	26	47	237	84.95
1-6 times a week	14	5	5	9	9	42	15.05
Occasionally	-	-	-	-	-	-	-
Tea/Coffee							
Once Daily	3	3	6	2	4	18	7.89
1-6 times a week	4	20	13	3	7	47	16.85
Occasionally	31	93	15	30	45	214	75.26

Table 4.9: Frequency of Foods consumed by Pastoralist Households during wet season in *Kajuru* LGA

Food Type	Frequency of Intake n =72						
							Percent
Dairy	Kallah	Tantatu	Kajuru	Iburu	Budah	Total	
Once Daily	13	20	6	5	7	51	70.83
1-6 times a week	2	10	4	2	1	19	26.39
Occasionally	-	-	1	-	1	2	2.78
Meat							
Once Daily	-	5	2	-	1	8	11.11
1-6 times a week	10	6	2	4	4	26	36.11
Occasionally	5	19	7	3	4	38	52.78
Eggs							
Once Daily	-	-	-	-	-	-	-
1-6 times a week	5	5	5	3	3	21	29.17
Occasionally	10	25	6	4	6	51	70.83
Legumes							
Once Daily	3	10	8	3	4	28	38.89
1-6 times a week	2	16	3	3	3	37	37.50
Occasionally	10	4	-	1	2	17	23.61
Cereals							
Once Daily	14	30	11	7	9	71	98.61
1-6 times a week	1	-	-	-	-	1	1.39
Occasionally	-	-	-	-	-	-	
Tubers							
Once Daily	1	1	1	-	1	4	5.55
1-6 times a week	1	2	3	1	1	8	11.11
Occasionally	13	27	7	6	7	60	83.34
Fruits							
Once Daily							
1-6 times a week	8	22	9	5	6	50	69.44
Occasionally	7	7	2	2	3	21	29.17
	-	1	-	-	-	1	1.39
Vegetables							
Once Daily	15	30	11	7	9	72	100
1-6 times a week	-	-	-	-	-	-	-
Occasionally	-	-	-	-	-	-	-
Tea/Coffee							
Once Daily	-	-	2	-	1	3	4.17
1-6 times a week	-	10	6	3	1	20	27.78
Occasionally	15	20	3	4	7	49	68.06

4.9 Micronutrient Status, albumin and Haemoglobin concentration of Pastoralist Children (6-59months)

Blood samples were collected from 74 children (6-59months) across the five wards surveyed in *Kajuru* LGA during dry season while for wet season only 33 blood samples were collected for analysis. The Mean HB Concentration of serum iron, zinc and albumin of the pastoralist children (6-59months) was 97g/l, 27mmol/L, 22mmol/L and 560mmol/L and 105g/l, 30mmol/L, 25mmol/L and 586mmol/L during dry and wet season respectively. Out of the 74 pastoralist children measured, 36 were Girls and 38 were Boys.

4.9.1 Serum Micronutrient, albumin and Haemoglobin concentration distribution

Micronutrient concentration in serum was distributed into two groups, normal and low. Values under the following ranges were considered deficient: Iron (8.95-30.4mmol/L for females and 11.6-31.3mmol/L for males), Zinc: (10-20mmol/l), Albumin (507-580mmol) and HB Conc. (< 110g/L). Table 4.11 and Table 4.12 show the distribution of serum iron, zinc, albumin and haemoglobin concentration.

Table 4.10: Micro-nutrient, albumin and Haemoglobin concentration of Pastoralist Children (6-59mths) Kajuru LGA

Variable		Girls N=36/13	Boys N= 38/20	Total N= 74/33
HB (g/L)	Dry Season	99.00±0.50	96.00±2.11	97.00±2.79
	Wet Season	104.00±0.50	106.00±2.11	105.00±2.79
Fe (mmol /L)	Dry Season	26.00±1.67	28.00±1.98	27.00±2.32
	Wet Season	29.00±1.67	31.00±1.98	30.00±2.32
Zn (mmol /L)	Dry season	22.00±1.17	21.00±2.51	22.00±1.75
	Wet season	26.00±1.17	24.00±2.51	25.00±1.75
Albumin (mmol /L)	Dry Season	586.00±0.17	535.00±0.12	560.00±1.51
	Wet Season	600.00±0.17	572.00±0.12	586.00±1.51

Values are Mean±SD. HB- Haemoglobin, Fe- Iron, Zn- Zinc.

Table 4.11: Serum Iron, Zinc, Albumin and Haemoglobin Concentration distribution for Dry season

Micronutrient	Status	Girls N=36		Boys N= 38		Total N=74	
		No	%	No	%	No	%
Fe	Normal	36	100	38	100	74	100
	Low	0	-	0	-	-	-
Zn	Normal	35	97.22	34	89.47	69	93.24
	Low	1	2.78	4	10.53	5	6.76
Albumin	Normal	22	61.11	18	47.37	40	54.05
	Low	14	38.89	20	52.63	6	45.95
Hb Conc.	Normal	14	38.89	23	60.53	37	50.00
	Low	22	61.11	15	39.47	37	50.00

Fe-Iron, Zn-Zinc, Hb Conc-Haemoglobin concentration. Distribution based on references on K-lab kits for Iron Zinc and Albumin and WHO (2011) reference for Hb concentration

Table 4.12: Serum Iron, Zinc and Albumin Concentration distribution for wet season

Micronutrient	Status	Girls N=13		Boys N= 20		Total N=33	
		No	**%**	**No**	**%**	**No**	**%**
Fe	Normal	13	100	20	100	33	100
	Low	0	-	0	-	-	-
Zn	Normal	13	100	18	90.00	31	93.94
	Low	0	-	2	10.00	2	6.06
Albumin	Normal	9	69.23	13	65.00	22	66.67
	Low	4	30.77	7	35.00	11	33.33
Hb Conc.	Normal	1	7.69	5	25.00	6	18.18
	Low	12	92.31	15	75.00	27	81.82

Fe-Iron, Zn-Zinc, Hb Conc-Haemoglobin concentration. Distribution based on references on K-lab kits for Iron Zinc and Albumin and WHO (2011) reference for Hb conc

4.10 Differences in the prevalence of Acute Malnutrition based on MUAC Cut-offs by season

Significant differences were observed when values for dry and wet seasons were compared. In the wet season, there was no case of severe acute malnutrition based on midupper arm circumference. This is shown in Table 4.13.

4.11 Differences in the Dietary Pattern of Pastoralist Households

As shown in Table 4.14, there were significant differences between the Dry and wet season in the frequency of intake for five (5) food types. These foods are dairy, eggs, tubers, fruits and vegetables.

4.12 Differences in the Micronutrient, serum albumin and Haemoglobin Concentrations

There were significant differences between values of haemoglobin, albumin, iron and zinc concentrations for both dry and wet seasons, but values were generally higher during the wet season. This is shown below in Table 4.15.

Table 4.13: Prevalence of acute malnutrition based on MUAC cut offs for different seasons

	Dry Season n = 581	**Wet Season** n = 145
Prevalence of global malnutrition (< 125 mm)	11.59±1.27[a]	12.23±1.34[b]
Prevalence of severe malnutrition (< 115 mm)	10.44±1.29	-

[a]Means with different superscripts are significantly different based on t- test at P<0.05

Table 4.14 Differences in Dietary patterns between dry and wet season

			Frequency of Intake			
Food Type	**Period**	**No**	**Once Daily (%)**	**1-6 times daily (%)**	**Occasionally (%)**	**p- value**
Dairy	Dry Season	279	13.98	16.49	69.53	**0.013***
	Wet Season	72	70.83	26.39	2.78	
Meat	Dry Season	279	2.15	13.62	84.23	0.493
	Wet Season	72	11.11	36.11	52.78	
Eggs	Dry Season	279	-	12.90	87.10	**0.009***
	Wet Season	72	-	29.17	70.83	
Legumes	Dry Season	279	16.13	26.88	73.12	0.181
	Wet Season	72	38.89	37.50	23.61	
Cereals	Dry Season	279	98.20	1.79	-	1.00
	Wet Season	72	98.61	1.39	-	
Tubers	Dry Season	279	20.43	67.38	12.19	**0.045***
	Wet Season	72	5.55	11.11	83.34	
Fruits	Dry Season	279	10.75	32.26	56.99	**0.054***
	Wet Season	72	69.44	29.17	1.39	
Vegetables	Dry Season	279	84.95	15.05	-	**0.00003***
	Wet Season	72	100	-	-	
Tea/Coffee	Dry Season	279	7.89	16.85	75.26	0.325
	Wet Season	72	4.17	27.78	68.06	

Table 4.15: Differences in Micro-nutrient concentration of Pastoralist Children (6-59mths) by season

Variable	Dry Season N=74	Wet Season N= 33
HB (g/L)	97.00±2.79[a]	105.00±4.38[b]
Fe (mmol /L)	27.00±2.32[a]	30.00±2.18[b]
Zn (mmol /L)	22.00±1.75[a]	25.00±2.25[b]
Alb(mmol /L)	560.00±1.51[a]	586.00±4.86[b]

Values are Mean±SD. HB- Haemoglobin, Fe- Iron, Zn- Zinc, Alb- Albumin
[a]Means with different superscripts are significantly different based on t- test at $P<0.05$

CHAPTER FIVE

5.0 DISCUSSION

The levels of Global Acute Malnutrition (Wasting) based on weight for height in pastoralist Fulani children (6-59months) was at emergency levels including stunting which was at a high prevalence according to the WHO classification (1995). Growth stunting constitutes the most common evidence of marginal malnutrition throughout the world. Protein and energy deficiency were initially evaluated as major causes of stunting (Amor *et al*., 1995). Children are in a rapid stage of growth and formation, with evolving physical and cognitive functions. The environment has long been recognized as a crucial determinant of child survival and health, with children especially susceptible to air and water quality, temperature, humidity, and vector borne infections due to their less developed physiology and immunity (UNICEF, 2008). During childhood, energy needs are higher than in adults. In young children the proportion of vital organs is much more important than the energy stocks. This explains why, in periods of stress and food shortages children are the first to be affected (ACF, 2015).

From the study, most of the pastoralist Fulani households had less access to income, food and health services and this may also limit their purchasing power, ability to buy nutritious food and provide adequate care for the vulnerable group. Many pastoralists live in marginal areas unsuited to agriculture or permanent settlement. Often they are geographically and culturally isolated, with a limited participation in the cash economy; access to primary health care and participation in rural development programmes (Sellen, 1996). Poor hygienic practices such as hand washing after defecating and handling a child were observed among the households and this may have increased susceptibility of children to infections.

The poor socio economic status of the mothers who were mostly unemployed and their poor educational background may have contributed to the high rates of under-nutrition among the under five children as they may not have adequate knowledge about the nutritional requirements of their children and even if they do; no purchasing power to buy nutritious meals for their children. The report computed from the NDHS, 2013 on nutritional status in northern Nigeria revealed that household economic status has a positive effect on child nutrition. Additional important factors in nutritional status include maternal education; the quality of healthcare facilities for women and children (which is particularly poor in the northern states); immunization levels; and women's in-comes, livelihoods, and overall empowerment (Ajieroh, 2009; Murphy, 2013).

The prevalence of wasting was high during the dry season among the children measured; this may be as a result of access to less food and reduced dietary intake; anthropometric data indicated that while seasonal effects on body size and composition may be weaker than might be expected; a large proportion of the children and most of the adults in African pastoralist populations fall below anthropometric reference data on weight and weight for height. This strongly suggests that the generally low food intakes reported for African pastoralists do play a significant role in producing growth deficits which persists into adulthood (Sellen, 1996).

Pastoral diets generally are characterized as high in protein but low in calories, with marked seasonal variation in both protein and energy content (Galvin and Little, 1999; Little *et al*., 1993). During dry periods as milk supplies diminish, small stocks are increasingly sold to purchase foods particularly grains (maize meal or *posho)* and other carbohydrates (sugar to mix with tea). Children who are fed a monotonous diet can suffer from under-nutrition, even

though they may not be hungry and may even be getting sufficient amounts of energy and protein (WHO, 2014). Information from the dietary pattern data showed that the pastoralist Fulani housheolds consumed mainly cereals particularly maize and millet with vegetable (Baobab leaves) soup; meat was hardly consumed and children were not given any special diets or mixtures. A review of dietary composition for eight pastoral populations clearly showed that dietary differences among them were quantitative rather than qualitative (Galvin, 1992) Milk products and cereals are always the major components of the diet, the former to a more variable extent. The relative annual contributions of different foods to total diets vary substantially among populations (Galvin, 1992). Some populations also utilize wild foods (Becker, 1983) and others purchase goods such as tea, sugar and oils (Galvin, 1992). Milk and milk products account for around 30% of the dietary energy of pastoral groups for Fulani (Gray, 1994). Meat consumption is negligible in some groups (Tuareg, Fulani, and Masaai) and is never as important as early reports suggested accounting for less than 10% of total calories in more than half the populations studied (Swift *et al*., 1990).

The prevalence of Severe Acute Malnutrition was highest in children aged 6-12months; the prevalence of Severe Acute Malnutrition (SAM) is higher among young children and declines after 24 months of age (Victora, 1992). Optimal feeding practices for infants and young children are the most effective means of improving child health. Exclusive breastfeeding was not practiced by any household as animal milk/water were also fed to the children but most of the women initiated breastfeeding less than an hour after birth and complementary feeding was introduced after 6 months by more number of households.

From the results of dry season, serum micronutrient concentrations of the children were mostly normal especially Iron and zinc concentration but albumin concentration was low in

almost half of the children studied. The iron status of the pastoralist children may be as a result of high consumption of vegetables particularly baobab. Vegetables are a major source of iron subject to chelation by oxalates, phytates, and other anti-nutrients, making it unavailable for absorption by the body (Chadare *et al.*, 2009). In general and regardless the variation in reported data, baobab pulp is rich in vitamin C, the leaves are rich in good quality proteins – most essential amino acids are present in the leaves – and minerals, and the seeds in fat. Moreover, pulp and leaves exhibit antioxidant activity (Chadare *et al.*, 2009).

Albumin was generally normal in over half of the pastoralist children measured which only improved by a small percent during the wet season. In cases of severely malnourished wasted children, serum total protein and albumin are expected to be normal or reduced (Jelliffe, 1989; Suskind, 1990). Serum albumin level is an important prognostic indicator. Serum albumin levels are dependent on the rate of synthesis, the amount secreted from the liver cell, distribution in body fluids, and level of degradation. Hypoalbuminemia results from a derangement in one or more of these processes. Low serum albumin levels are an important predictor of morbidity and mortality (Peralta *et al.*, 2016).

During the wet season, all children had normal concentrations of haemoglobin, zinc and iron, compared to dry season. This may be due to increased availability of other foods during the rainy season particularly milk, fruits and some vegetables like spinach which are good sources of micronutrients. Nomadic pastoral diets are typically protein-rich and calorie-poor based on three food groups: milk, meat products, and cereals acquired by trade or cultivation. Meat products are rarely consumed, where animals are slaughtered for ritual occasions or social obligations. Milk accounts for 30% of diets of Fulani (Sellen, 1996) and there is marked seasonal variation in consumption of these products, where milk is consumed mainly

in the short wet seasons and people turn to cereals as pastoralists sell livestock (usually goats and sheep) to purchase maize meal, sugar, tea, and tobacco, which yield little more than immediate calories and stimulant to avoid hunger (Galvin and Little 1999). Milk is high in protein and micronutrients including vitamins A, C, and calcium.

There were significant differences in the nutritional indicators measured during dry and wet seasons particularly in the prevalence of acute malnutrition and micronutrient status; Research has found significant seasonal variation in weight-for-age (Abdallah *et al.*, 1985), weight-for-height (Hassan *et al.,* 1985), growth velocity (Branca *et al.*, 1993), clinical diagnoses of malnutrition (Trowbridge *et al.*, 1982), and iron status (Hassan *et al.*, 1985). Fluctuations in height-for-age have been less consistently demonstrated (Branca *et al.*, 1993), probably because this indicator is less likely to be affected by short, cyclical changes in nutritional status. Typically children's nutritional status, as measured by weight-for-height or weight-for-age, is worst during the rainy season or prior to harvest and best during the months following harvest. The magnitude of seasonal fluctuation tends to be smaller in regions with bimodal rainy seasons (Schofield, 1974) and agricultural systems that include multiple harvests over the course of the year (Teokul *et al.*, 1986).

Overall, this study found season to have a significant effect on both nutritional status and micronutrient status among children in Kajuru LGA, Season may also have a greater impact on children in poorer households (Schofield 1974). Researchers typically suggest three main pathways through which season has this effect on nutritional status: an increase in morbidity during the rainy season (Schofield *et al.*, 1974), a decrease in food availability during the pre-harvest season (Branca *et al.*, 1993), and fluctuating demand for female labour and its impacts on caring practices (Abdullah *et al.*, 1985). In rural areas, illness (particularly

specific, seasonal strains of diarrhoea) has been identified as a primary link between season and nutrition (Marin *et al.*, 1996). Dietary diversity and household income have also been suggested (Garrett and Ruel, 1999).

Specific mechanisms for the etiology of under-nutrition remain unclear. More data on dietary quality and more longitudinal observational studies of child growth and its relation to a variety of possible causal factors are needed. There is evidence that low energy and protein intakes may not be the prime cause of growth faltering and marginal under-nutrition in all populations. The importance of infection in the etiology of under-nutrition and seasonal fluctuations in nutritional status remains poorly evaluated despite very early interest by human biologists. Disease ecology and socio-economic disadvantages will interact with diet to produce under-nutrition (Sellen, 1996).

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary Findings

i. The prevalence of stunting, underweight and wasting during the dry season were 23.4%, 20.3% and 14.5% respectively

ii. Boys were more severely wasted (3.0%) than girls (2.5%) while girls showed a higher percentage of severe underweight (6.8%) compared to boys (3.3%) and for stunting boys showed a higher percentage (12.5%) than girls at 7.6%.

iii. Overall, the age group that had highest percentage of all indicators were children between 6-12months.

iv. During the Wet season, the prevalence of stunting, underweight and wasting were recorded at 37.2%, 13.1% and 4.8% respectively.

v. Boys and Girls were at same levels of severe wasting (1.4%), while for severely underweight girls showed comparatively lower levels (1.4%) than boys (5.5%). Prevalence of severe stunting was also higher among boys (23.3%) than girls (8.3%) and the age group with the highest levels of all indicators was 6-12months.Cereals and Vegetables were the most frequently consumed foods both during dry and wet season with dairy also being consumed at high levels during the wet season.

vi. Concentrations of micronutrients measured were mostly normal during both seasons except for albumin which showed only 54% normal during dry season and 67% within normal levels during wet season.

6.2 Conclusion

The survey findings revealed that there was a significant effect of season on the dietary pattern and nutritional balance of pastoralist under five children measured. Poor dietary intake and sub-optimal infant and young child feeding practices such as non-practice of exclusive breastfeeding (it is customary to give a new born water or animal milk first), late initiation of breastfeeding and undiversified complementary foods given to children including poor hygienic practices exposed them to higher risk of malnutrition and death.

6.3 Recommendations

i. Community outreach programme can be set up in these pastoralist areas as most of the existent cmam programmes are not extended to hard-to-reach areas where most of the pastoral households are based. Creating and expanding interventions to cater for pastoral Fulani populations may help improve nutritional status particularly in dry season.

ii. Special interventions such as supplementary or blanket feeding programme can be advocated for the pastoralist households; this will particularly be useful as it will help cushion the effect of the losses they faced from the loss of their livestock to cattle rustlers, in some cases even household heads. Advocacy can be made to the Government or LNGOs or INGOs.

iii. Greater care and improvement of women's and girls' status overall will result healthier babies and children. Increasing awareness of and support for the nutritional needs of pregnant women, combined with increasing girls' access to education, and supporting women to benefit from improved means of livelihood and opportunities.

iv. .

v. Nutrition education should carry messages that can improve infant and young child feeding practices and hygienic promotion in the households. Health workers and community volunteers who are members of their community can be trained and used to pass on these messages in form of mother-to-mother support groups.

vi. Interventions are also required to improve access to a healthy environment and to reduce morbidities associated with malnutrition. Some of these interventions could be Micronutrient powder supplementation, provision of routine drugs, improved access to safe drinking water and provision of adequate health workers who can attend to caregivers timely and appropriately.

vii. Further Nutrition screenings can be carried out to detect levels and causal factors of malnutrition among Fulani People. The information generated from such research can be used to design context-specific interventions that will have a direct impact.

viii. The Nomadic Education Programme should be reviewed and adequately financed to ensure enrolment of the Fulani children.

REFERENCES

Abaje, I.B., Sawa B.A., Iguisi E.A. and Ibrahim A.A. (2015). Assessment of Rural Communities' Adaptive Capacity to Climate Change in Kaduna State, Nigeria. *Journal of Environment and Earth Science ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online) 5, (20).*

Abbass, I.A. (2014). *'No Retreat No Surrender': Conflict for Survival Between Fulani Pastoralists and Farmers in Northern Nigeria.* Retrieved on 22 April 2017 from *https://www.google.com.ng/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwj6oqHT87fTAhXLuo8KHQzwByAQFgggMAA&url=http%3A%2F%2Feujournal.org%2Findex.php%2Fesj%2Farticle%2FviewFile%2F4618%2F4414&usg=AFQjCNFAcoyYke-QVXIsFBB07YKItfxhSA*

Abbass, M. (2012).“No retreat no surrender conflict for survival between Fulani pastoralists and farmers in Northern Nigeria”. *European Scientific Journal,* 8 (1). 331-346.

Abdulai, A. and Aubert, D. (2004). Nonparametric and Parametric Analysis of Calorie Consumption in Tanzania. *Food Policy,* 29, 113-129.

Abdullah, M. and Wheeler, E. (1985). Seasonal variations and the intra-household distribution of food in a Bangladeshi village. *American Journal of Clinical Nutrition* 1985; 41:1305–13.

ACC/SCN, (2000). Fourth report on the world nutrition situation. United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition, Geneva.

Action Contre la Faim, (2012). *The essential; the key to understand Nutrition & Health and ACF position* available from http://blog.actioncontrelafaim.org/wp-content/uploads/2013/06/The-Essential-ACF-nut-and-health-EN-2012.pdf. {Accessed on 02.11.2016}.

Admassu, B. (2003). *Primary Animal Health Care in Ethiopia:* The experience so far Veterinary Field Officer Community-based Animal Health and Participatory Epidemiology unit AU/IBAR/CAPE, pp 1-13.

Akachi, Y. Goodman, D. and Parker, D. (2009). Global Climate Change and Child Health: A review of pathways impacts and measures to improve the evidence base. Discussion Paper IDP No. 2009-03, *UNICEF Innocenti Research Centre*, Florence, June 2008: 8.

Akinlosotu, R.A. and Hussain, M.A. (1985). The usefulness of height at first year of schooling as an index of nutritional status of a community. *Nigerian Journal of Nutritional Science,* 6(2): 131-138.

Apley, J. (1979). *Pediatrics.* 2nd Edn., Castel Limited Publishers, London, pp: 27-28.

Beal, V.A. (1990). A critical review of dietary survey method, part one: *Food and Nutrition news*, vol. 4, No. 3, pp 1-4.

Beaton, G., Kelly, J., Kevany, R. and Mason, J. (1990). Appropriate uses of Anthropometric Indices in Children. ACC/SCN state of the art series on *Nutrition Policy Discussion* Paper No 7, United Nations Administrative Committee on Coordination/Subcommittee on Nutrition, pp: 1-51.

Becker, B. (1983). The contribution of wild plants to human nutrition in the Ferlo (Northern Senegal). *Agrofor Syst (*1*):* 257-267.

Black, R., Victora C., Walker S., Bhutta Z., Christian, P., de Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., Uauy, R. (2013) and the Maternal and Child Nutrition Study Group, (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet*. 382 (9890): 427-51.

Blaney, S., (2009). Determinants of under nutrition in rural communities of a protected area in Gabon. Public health nutrition 2009; 12(10):1711-1725.

Blench, R. (2004). *Natural resource conflicts in North-Central Nigeria: A handbook and case studies*. Mallam Dendo Ltd., Cambridge; 2004.

Blench, R. (2001): *Pastoralism in the new millennium*. Retrieved from https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/6329.pdf. [Accessed June 2014].

Blench, R.M. (1996). *Pastoralists and National Borders in Nigeria*. In: Nugent, P., and A. I. Asiwaju (eds) African Boundaries: Barriers, conduits and opportunities. 111–128. Edinburgh: Francis Pinter for Centre of African Studies.

Bonfoh, B. (2007). New approaches in health and social services provision for nomadic people in the Sahel. *5th European Congress on Tropical Medicine and International Health*:223-229.

Brainard, J., (1986). Differential mortality in Turkana agriculturalists and pastoralists. *American Journal of Physical Anthropology*; 70, 525–536.

Branca, F. Pastore, G., Demissie, T, and Ferro-Luzzi, A. (1993). The nutritional impact of seasonality in children and adults of rural Ethiopia. *European Journal of Clinical Nutrition* 1993;47:840–50.

Bruijn de, M., Dijk, van, H. (1995). Arid Ways: *Cultural Understanding of Insecurity in Fulbe Society*, Central Mali, Amsterdam, Thela Publishers 547pp

Bryce, J., Arifeen, S., Pariyo, G., Lanata, C.F., Gwatkin, D., and Habicht, J.P. (2003). Reducing Child Mortality: Can Public Health Deliver? *The Lancet* 362 (9378): 159–164.

Chabasse, D., Roure, C., Rhaly, A.A., Maiga, D., Traore, M., Tounkara, A., Dumon, H., and Ranque, P. (1983). Evaluation de l'e´tat sanitaire des populations nomades et semi-nomades du Gourma-Mali-Approche e´pide´miologique. *Me´decine Tropicale* 43, 127–135.

Chopra, R., Maurice, E.S., and Sheinbaum R.C., (2003): Modern Nutrition in Nutritional Requirements: 85-87.

Coughenour, M.B. (1985). "Energy Extraction and Use in a Nomadic Pastoral Ecosystem." *Science* 230: 619-25.

Davidson, L. (2002). Potential benefits of small livestock production on human micronutrient status and health. Proceeding of the ZIL Annual Conference - Future role of food security and poverty reduction, Swiss Centre for International Agriculture, Zurich, Switzerland.

Davidson, S., Passmore, P., Brock, J.F., and Truswells, A.S. (1975). *Human Nutrition and Dietetics*. ELBS Church Living Stone Publishers, Great Britain, pp: 20.

De, B.B., Andersson, M., Takkouche, B., and Egli, I. (2003). Prevalence of iodine deficiency worldwide. *Lancet* 29; 362(9398):1859-60.

De Benoist, B., McLean, E., Andersson, M, Rogers, L. (2007). Iodine deficiency in 2007: global progress since 2003. *Food Nutrition Bulletin* 2008;29:195–202.

Doumas, B.T., Watson, W.A., and Biggs, H.G., (1971). Albumin standards and the measurement of serum albumin with bromcresol green. *Clinica Chimica Acta*; 31(1):87-96.

Dunneram, Y., and Jeewon, R. (2013). A scientific assessment of socio-demographic factors, physical activity level, and nutritional knowledge as determinants of dietary quality among indo-mauritian women. *Journal of nutrition and metabolism*, 2013.

Dupuy, M., Godeau, E., Vignes, C., and Ahluwalia, N. (2011). Socio-demographic and lifestyle factors associated with overweight in a representative sample of 11-15 year olds in France: results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) crosssectional study. *BMC Public Health*, 11(1), 442.

Dyson-Hudson, R. and Smith, E.A. (1978). 'Human Territoriality: An Ecological Reassessment', American Anthropologist, 80(1): 21-41.

Echendu C.A. and Onimawo I.A., (2003). Incidence of anaemia among pregnant women in urban and rural areas of Umuahia, Nigeria. *Nigerian Journal of Nutritional Science*. 2003; 24; 1 & 2: 4-12.

Edmond, K.M., (2006). Delayed Breastfeeding Initiation Increases Risk of Neonatal Mortality. *Pediatrics*, 117(3): p. e380-386.
Ekpo, U. F., Omotayo, A.M., And Dipeolu, M.A. (2008). Changing lifestyle and prevalence of malnutrition among settled pastoral Fulani children in Southwest Nigeria. Annals of agricultural and environmental medicine 15(2): 187-91.

Eniola, F., (PhD), (2007). Key Issues in Livelihoods Security of Migrant Fulani Pastoralists: Empirical Evidence from Southwest Nigeria. *"African Alternatives: Initiative and Creativity beyond Current Constraints"* 11 - 14 July 2007, African Studies Centre, Leiden.

Ezekwe, J.C., (2008). Impact of Nutrition on the National Education and Healthy Growth. http://ezinearticles.com/?expert=Nzekwe_Justin_C. [accessed September 11 2017].

FAO, (2003). Guideline for developing an affective national food control system. Rome.

FAO, (2010). Global Forest Resources Assessment 2010: Main report. FAO Forestry Paper 163. Rome.

FEWS NET. (2004.) Famine early warning system: National livelihood profiles.http://www.fews.net/sectors/medios-de-vida. [Accessed 19 June 2009].

Foggin, P., Farkas, O., Shiirev-Adiya S., and Chinbat, B. (1997). Health status and risk factors of semi-nomadic pastoralists in Mongolia. *Social Science & Medicine*, 44, 1623–1647.

Fratkin, E M, Roth E.A., and Nathan, M.A. (1999). When nomads settle: The effects of commoditization, nutritional change, and formal education on Ariaal and Rendille pastoralists. *Current Anthropology* 40(5):729-735.

Fratkin, E M, Roth E.A., and Nathan, M.A. (2004). Pastoral sedentarization and Its effects on children's diet, health, and growth among Rendille of Northern Kenya. *Human Ecology* 32(5):531-559.

Fratkin, E.M. and E.A. Roth (2004). As Pastoralists Settle: Social, Health, and Economic Consequences of Pastoral Sedentarization in Marsabit District, Kenya. New York: Kluwer Plenum Press.

Frongillo, E. A. (1999). Symposium: Causes and Etiology of Stunting. Introduction. The Journal of nutrition, 129(2S Suppl), 529S–530S. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10064324 on July 20 2017.

Fujita, M., Fratkin, E M, Roth E.A., and Nathan M.A (2004). Sedentism, Seasonality and Economic Status: A Multivariate Analysis of Maternal Dietary and Health Statuses Between

Pastoral and Agricultural Ariaal and Rendille Communities in Northern Kenya. *American Journal of Physical Anthropology* 123(3): 277-91.

Galvin, K.A. and Little, M.A. (1999). *Dietary intake and nutritional status In Turkana Herders of the Dry Savanna*: Ecology and biobehavioral response of nomads to an uncertain environment. Edited by Michael A. Little and Paul W. Leslie, pp. 125- 145. New York: Oxford University Press.

Gardner, J.M., Grantham-McGregor, S., Himes, J. and Chang, S. (1999). "Behaviour and Development of Stunted and Nonstunted Jamaican Children." *Journal of Child Psychology and Psychiatry*. 40 (5), pp. 819–827.

Garrett, J, and Ruel, M. (1999). Are determinants of rural and urban food security and nutritional status different? Some insights from Mozambique. *World Development* 1999; 27:1955–75.

Goossens, S., Bekele, Y., Yun, O, Harczi, G., Ouannes, M, Shepherd, S., (2012). Mid-upper arm circumference based nutrition programming: Evidence for a new approach in regions with high burden of acute malnutrition. *Public Library of Science* One 7(11):e49320.

Gray, S., Sundal, M., Wiebusch, B., Little, M.A., Leslie, P.W. and Pike, I.L. (2003). 'Cattle Raiding, Cultural Survival, and Adaptability of East African Pastoralists', *Current Anthropology,* 44(S): S3-S30.

Hakeem, R., Shaikh, A.H., Asar, F. (2004). Assessment of linear growth of affluent urban Pakistani adolescents according to CDC 2000 references. *Annals of Human Biology*. 2004, 31: 282-291. 10.1080/03014460310001658800.

Hampshire, K. R., (2002). Networks of nomads: negotiating access to health resources among pastoralist women in Chad. *Social Science and Medicine* 54: 1025–1037.

Hassan, N, Huda, N, Ahmad, K. (1985). Seasonal patterns of food intake in rural Bangladesh: Its impact on nutritional status. *Ecology Food Nutrition* 1985;17:175–86.

HemoCue® 2014: (HemoCue AB). Operating Manual. Ångelholm, Sweden

Herbert, V. (1992). Everyone should be tested for iron disorders. *Journal of American Dieticians. Association*; 1992; 92:1502-1509.

Hilderbrand, K. (1985). Assessing the components of seasonal stress amongst Fulani of the Seno-Mango, Central Mali. In "Population, Health and Nutrition in the Sahel" (Hill A.G., Ed.), pp. 254-283, KPI Limited, London, Boston, Melbourne and Henley.

Hill, A. G. (ed.) (1985). Population, Health and Nutrition in the Sahel: Issues in the Welfare of Selected West African Communities. London: Routledge and Kegan Paul.

Holden, S., Ashley, S., Bazeley, P. (1997). *Livestock and Poverty Interactions: A review of the literature*. Report to DFID. Available from Livestock in Development, Somerset,UK.

IFAD, (2001). Rural poverty report 2001: *The Challenge of ending rural poverty*. Oxford University Press, for International Fund for Agricultural development.

Iliyasu, U. (2012). *The place of Fulfulde in nomadic education in Nigeria* (121-124) Journal of Igbo Language & Linguistics 5, 2012 ISSN – 05987518 http://www.linguisticsafrikana.com

International Conference on Nutrition, (1992) Rome. National Institute of Nutrition No. 33.
International Food Policy Research Institute. (2014). Global Nutrition Report 2014: *Actions and Accountability to Accelerate the World's Progress on Nutrition*. Washington, DC.

Iro, I. (2004). From Nomadism to Sedentarism: *An Analysis of Development Constraints and Public Policy Issues in the Socioeconomic Transformation of the Pastoral Fulani of Nigeria [INTRODUCTION]*. Available from http://www.gamji.com/fulani1.htm

Islam, I. (2001). From Nomadism to Sedentarism: An Analysis of Development Constraints and Public Policy Issues in the Socioeconomic Transformation of the Pastoral Fulani of Nigeria.

Jelliffe, D.B., Jelliffe, E.F.P. (1989). *Community nutrition assessment*. Oxford, Oxford University Press, 1989, pp 39-48, 273-351.

John Hopkins University, (2015). The Office of the UN Special Envoy for the health-MDGs, the Office of the UN Special Envoy for the health-MDGs, the World Bank, Partners in Health, Last Mile Health, the Clinton Foundation, ALMA, the Governments of Ethiopia and Liberia, *Strengthening Primary Health Care through Community Health Workers: Investment case and financing recommendations*, New York, July 2015.

Johnsen, and Eliasson, R. (1987). Evaluation of a commercially available kit for the colorimetric determination of zinc. *International Journal of Andrology*, 1987; 10(2): 435-440.

Johnson, D.L. (1969). *The Nature of Nomadism: A comparative study of pastoral migrations in Southwestern Asia and Northern Africa*. Department of Geography, Research Paper 118. Chicago: University of Chicago.

Jones, G., (2003). How many child deaths can we prevent this year? (Child Survival Series) *Lancet* 2003 Vol. 362.

Khuwaja, S., Selwyn, B.J. and Shah, S.M. (2005). Prevalence and correlates of stunting among primary school children in rural areas of Southern Pakistan. *Journal of Tropical Pediatrics* 2005;51:72–7.

Kuku-Shittu, O., Onabanjo, O., Fadare, O. and Oyeyemi, M. (2016). Child malnutrition in Nigeria: Evidence from Kwara State. NSSP Working Paper 33. Washington, D.C.: International Food Policy Research Institute (IFPRI). http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130499.

Lambrecht, F., (1976). The Pastoral Nomads of Nigeria *Expedition Magazine* 18.3 (May 1976): *Expedition Magazine*. Penn Museum, May 1976 Web accessed 14 May 2014 (http://www.penn.museum/sites/expedition/?p=3064)

Lavy, V., Strauss, J., Thomas, D. and de Vreyer, P. (1996). Quality of health care, survival and health outcomes in Ghana. *Journal of Health Economics* 1996; 15:333–57.

Little, P.D. (1994). *Maidens and milk markets: the sociology of dairy marketing in Southern Somalia*. In: African pastoralist systems. An integrated approach, E. Fratkin, K.A. Galvin and E.A. Roth (eds.), Chapter 9, 165-184. Boulder and London: Lynne Rienner Publishers, Inc.

Louis, E.E., (2014). A socio-cultural exposition of the Fulani nomads in Nigeria. Available from http://www.academia.edu/5110830/A_socio-cultural_exposition_of_the_Fulani_nomads_in _Nigeria accessed on June 03 2013.

Loutan, L. (1989). Les proble`mes de sante´ dans les zones nomades. In: Rougemont, A., Brunet-Jailly, J. (Eds.), Planifier, Ge´rer, Evaluer la Sante´ en Pays Tropicaux. Doin Editeurs, Paris, pp. 219–253

Lutter, C. (2010), *Early Initiation of Breastfeeding*: The Key to Survival and Beyond. Healthy Life Course Project, Family and Community Health, Pan American Health Organization 525 23rd Street, NW, Washington D.C. 20037.

Mahan, L.K. and Stump, S.E. (2000). *Food, Nutrition and Diet therapy*. 10th edition USA.

Majekodunmi, O.A., Fajinmi, A., Dongkum, C., Shaw, A.P.M. and Welburn, S.C. (2014): Pastoral livelihoods of the Fulani on the Jos Plateau of Nigeria. Pastoralism: *Research, Policy and Practice 2014 4:20*.

Mamabolo, R.L., Alberts, M., Steyn, M.P., Delemarre-van de Waal, H.A. and Levitt, N.S. (2007). Prevalence and determinants of stunting and overweight in 3-year-old black South African children residing in the Central Region of Limpopo Province, South Africa. *Public Health Nutrition* 2007; 8:501–8.

Marcia, N., (2007). *Nutrition through Health-Care Systems*. World Health Organization, Geneva, (document no. NUT/77.1).

Marin, C.M., Segura, J.L., Bern, C., Freedman, D.S., Lescano, A.G., Benevente, L.E., Cordero, L.G., Gilman, J.B. (1996). Seasonal change in nutritional status among young children in an urban shanty town in Peru. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 1996;90:442–5.

Maziya-Dixon, B., Akinyele, I. O., Oguntona, E. B., Nokoe, S., Sanusi, R. A., and Harris, E. (2004). Nigerian Food Consumption and Nutrition Survey 2001–2003, Summary. *International Institute of Tropical Agriculture (IITA),* Ibadan, Nigeria.

Mccabe, J T. (1994) *Mobility and land use among African pastoralists: Old conceptual problems and new interpretations.* In African pastoralist systems. An integrated approach. E. Fratkin, K.A. Galvin, and E.A. Roth, eds. Pp. 69-90. Boulder: Lynne Rienner Publishers.

Michael, B.J. (1987). Milk production and sales by the Hawazma (Baggara) of Sudan: implications for gender roles. *Research in social anthropology*, 9:105-141.

Mocellin, J., and Foggin, P. (2008) Health status and geographic mobility among semi-nomadic pastoralists in Mongolia. *Health and place* 14(2):228-42.

Multiple Indicators Clusters Survey (MICS), (2011). Multiple Indicators Clusters Survey. Monitoring the Situation of Children and Women. UNICEF/NBS/UNFPA.

Munch, A. (2007) The meaning and representation of illness, health and curing among the Kel Tamasheq in northern Mali. *Tropical Medicine & International Health* 12:204-204.

Murphy, L. (2013). ORIE Research Summary 3. Nutritional Status in Northern Nigeria, Prevalence and Determinants: a Review of Evidence available from http://www.heart-resources.org/wp-content/uploads/2013/09/ORIE_RSummary3_Evidence_Web.pdf.

Nathan, M. A., Fratkin, E. and Roth, E.A. (1996). Sedentism and Child Health among Rendille Pastoralists of Northern Kenya. *Social Science and Medicine* 43(4): 503-515.

National Population Commission, (2006*). Population Estimate for Nigeria 2006*. A published Report by the National population commission, Abuja,Nigeria, Pp10-15.

Nicolaisen, J. and Nicolaisen I. (1997). The pastoral Tuareg: ecology and culture.. *Nomadic Peoples* 5 (2) Special Issue: Environment, Property Resources and the State (2001), pp. 172-175

Nigeria Demographic and Health Survey (NDHS), (2008). Nigeria Demographic and Health Survey.

Nigeria Demographic and Health Survey (NDHS), (2013). *Nigeria Demographic and Health Survey.*

Nori, M. (2007). '*Mobile livelihoods, patchy resources and shifting rights:* approaching pastoral territories' Working Discussion Paper, International Land Coalition.

Nori, M., Switzer, J., and Crawford, A., (2005). - Herding on the Brink: Towards a Global Survey of Pastoral Communities and Conflict - An Occasional Paper from the IUCN Commission on Environmental, Economic and Social Policy; Gland (Ch) http:// www.iisd.org/publications/pub.aspx?id=705.

Onimawo, I.A., Amangbangwu, K.E. and Eluwa, M.A., (2006). Nutritional Status of school aged children assessed by methods. *Nigerian Journal of Nutritional Science*., 1(2): 27-34.

Onis, M., Frongillo, E.A., and Blossner, M., (1980): Is malnutrition declining? An analysis of change in levels of child malnutrition since 1980. *Bull World Health Organ* 2000, (10) 1222-1223.

Onyesili, F.N., (2000). Nutrition Education in Child Development and Eradication of Disease. Invited Paper for the 31st Annual Conference and Scientific Meeting of the Nutrition Society of Nigeria Nov. 7 2000, Banquet Hall, National Centre Women for Development, Abuja.

Osilesi, (1992) "Physical growth: National Center for Health and Statistics Percentiles, American *Journal of Clinical Nutrition*, 32:607-629.

Osita, E. K., (2014). 'The Impact of Water and Sanitation on Childhood Mortality in Nigeria: Evidence from Demographic and Health Surveys, 2003–2013', *International Journal of Environmental Research and Public Health*, 11 (9) September 2014, pp. 9256−9272.

Özaltin, E., Hill, K., Subramanian, S.V., (2010). Association of Maternal Stature with Offspring Mortality, Underweight, and Stunting in Low- to Middle-Income Countries. *Journal of the American Medical Association* 303(15) 1507.

Panter-Brick, C. (1998), Biological anthropology and child health: context, process and outcome. In, Biosocial Perspectives on Children. Catherine Panter-Brick, editor. Cambridge: Cambridge University Press.

Pelletier, D.L., (1995). The food-first bias and nutrition policy: Lessons from Ethiopia. *Food Policy* 1995; 20:279–98.

Peralta, R. (2016). Hypoalbuminemia, *Medscape.* Retrieved from http://emedicine.medscape.com/article/166724-overview. [Accessed on July, 2016].

Pike, I. L. (2010). Documenting the health consequences of endemic warfare in three pastoralist communities of northern Kenya: A conceptual framework. *Social Science and Medicine 70(1):45-52.*

Pike, I.L. (2000). 'Pregnancy Outcome for Nomadic Turkana Pastoralists of Kenya', American *Journal of Physical Anthropology,* 113(1): 31-45.

Pollit, E. (1997). Iron deficiency and educational deficiency. *Nutrition Reviews*. 1997; 55: 133141.

Pyke, S.K., (1979). *Succeeding Generations: On the Effect of Investment in Children*. Russell Sage Foundation, pp: 72-81.

Randolph, T. F. (2007). Invited Review: Role of livestock in human nutrition and health for poverty reduction in developing countries. *Journal of Animal Science* 85(11):2788-2800.

Rass, N. (2006). *Policies and strategies to address the vulnerability of pastoralists in sub-Saharan Africa*. Pro-Poor Livestock Policy Initiative, Food and Agriculture Organisation of the United Nations, Rome; 2006.

RIM (Resource Inventory and Management), (1992). Livestock resource survey 1992.

Ruel, M, Levin, C.E, Armar-Klemesu, M, Maxwell, D. and Morris, S.S. (1999). *Good care practices can mitigate the negative effects of poverty and low maternal schooling on children's nutritional status*: Evidence from Accra. FCND Discussion Paper No. 62. Washington, D.C.: International Food Policy Research Institute, 1999.

Save the Children UK, (2016). *Child Malnutrition in Northern Nigeria: An Illustrative Case* Save the Children, 2014. Nutrition Governance Study: a national and Upazila level assessment; Save the Children, 2011. The status of community based health workers in rural Bangladesh; ICDDR-B, 2014. Preliminary findings from evaluation of NNS and Community Clinics; Chaudhury, Nazmul and Jeffrey S. Hammer. 2003. "Ghost Doctors: Absenteeism in Bangladeshi Health Facilities." *World Bank Economic Review* 18(3): 423–441, doi: 10.1093/wber/lhh047.

Saxena, A., Shubha, R., Phadke, S. and Agarwal, S., (2000). Linear catch-up growth. *Indian Journal of Pediatrics, 2000; 67 (3) : 225-230.*

Simondon, K.B. and Simondon, F. (1993) "Mothers Prolong Breastfeeding of Undernourished Children in Rural Senegal*" International Journal of Epidemiology* (27), pp. 490 494.

SUN, Scaling Up Nutrition. (2010). Progress report from countries and their partners in the Movement to Scale Up Nutrition. New York: UN, 2010.

Schelling, E. (2005). Morbidity and nutrition patterns of three nomadic pastoralist communities of Chad. *Acta Tropica* 95(1):16-25

Schelling, E. and Wyss, K. (2005). "Synergy between public health and veterinary services to deliver human and animal health interventions in rural low income settings." *British Medical Journal* 331(7527): 1264-1267.

Schiller, N.G., Linda, B. and Christina, B. (1998). *Transnationalism: A New Analytical Framework for Understanding Migration.* In: Towards a Transnational Perspective on Migration: Race, Class, Ethnicity, and Nationalism Reconsidered, 1-24, eds. Nina Glick, Schiller, Linda Basch and Christina Blanc-Szanton. New York: New York Academy of Sciences.

Sheik-M. and Hohan, P., and Velema, (1999). Where health care has not access: The nomadic populations of Sub-Saharan Africa. Tropical Medicine and International Health 4: 695. www.blackwell-synergy.com/links/doi/10.1046/j.13653156.1999.00473.x/abs.

Schofield, S. (1974). Seasonal factors affecting nutrition in different age groups and especially preschool children. *Journal of Development Studies* 1974; 2:22–40.

Schwartz, H.J. (1993). *Pastoral production systems in the dry lowlands of Eastern Africa*. In "Pastoral Production in Central Somalia" (Baumann M.P.O., Janzen J. and Schwartz H.J., (eds.), Humboldt University of Berlin, Berlin D-10115, Germany, pp. 1-16

Scoones, I. (1994). Living with Uncertainty: New Directions in Pastoral Development in Africa. London: Intermediate Technology Publications.

Sellen, D.W., (1996). Nutritional Status of Sub-Saharan African Pastoralists: A review of literature. *Nomadic Peoples* 39:107-134.

Sellen, D.W, (2010). Mobility, Animal Source Foods and Micronutrient Needs among African Pastoralists. *Society Biology and Human Affairs* 75(2):27-51

Sepu´ lveda-Amor, J. (1995) De´ ficit de talla y emaciacio´ n en menores de cinco an˜ os en distintas regiones y estratos en Me´ xico. *Salud Publica Mexico* 37: 95–107.

Shetty, P. (2002) *Measures of nutritional status from anthropometric survey data.* Retrieved on 27 July, 2016 from http://www.fao.org/docrep/005/y4249e/y4249e0b.htm

Shetty, P.S. and James W.P.T. (1994). *BMI as a measure of chronic energy deficiency in adults*. FAO, Food and Nutrition Paper, No 56.

Srilakshmi, B (2006). *Nutrition Science*. Published by New Age International Pvt Ltd., New Delhi.*Study.* Tools for Food Security and Nutrition Analysis. [Online]. Available from: http://www.heawebsite.org/countries/nigeria/reports/child-malnutrition-norther-nigeria-illustrative-case-study [Accessed 17th November 2016].

Suskind, R.M. and Suskind, L.L. (1990). The malnourished child, Nestle nutrition workshop series- 19. New York, Raven Press, 1990, pp 23-72.

Swift, J., Toulmin, C. and Chatting, S. (1990). Providing Services for Nomadic People, a Review of Literature and Annoted Bibliography. Unicef Staff Working Papers, No. 8, UNICEF, New York.

Tanner, M., Lengeler, C. and Lorenz, N. (1993). From the efficacy of disease control tools to community effectiveness: case studies from the biomedical and health systems research activities of the Swiss Tropical Institute in Africa. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 87 (5): 518-523.

Tanner, M., and Zinsstag, J. (2009) "One Health" - The potential of closer collaboration between human and animal health. *Berliner Und Munchener Tierarztliche Wochenschrift* 122(11-12):410-411.

Teokul, W, Payne, P. and Dugdale, A. (1986). Seasonal variations in nutritional status in rural areas of developing countries: A review of the literature. *Food Nutrition Bulletin*; 8:7–10.

The State of the World's Children, (2016). *A fair chance for every child.* Available from https://www.unicef.org/sowc/.

Thrusfield, M. (2005); *Veterinary Epidemiology*. 2nd ed. UK: Black Well Science. P 180.

Tiez, N.W., Prude, E.L. and Sirgard, A.O., (1994). In: Tiez textbook of Clinical Chemistr. (Burtis C.A. and Ashwooed E.R. eds) WBS Saunders Company, London. 1994: 1354-1374.

Trowbridge, F.L. and Stetler, H.C. (1982). Results of nutritional status surveillance in El Salvador, 1975–77. *Bulletin of the World Health Organization* 1982; 60:433–40.

UNICEF, (1998). *The State of the World's Children*. Oxford University Press, Oxford.

UNICEF, (2007). Global *Study on Child Poverty and Disparities 2007-2008 Guide*. Global Policy Section, Division of Policy and Planning. New York.

UNICEF, (2008). *The State of Africa's Children*, 2008: Child Survival.

UNICEF, (2009). *The prodecure to measure MUAC.* Available from https://www.unicef.org/nutrition/3.1.3/1.html. [Accessed January 2015].

UNICEF. (2007). "Iodine Deficiency: *A Continuing Threat to Development*. How Seven Countries in Eastern snd Southern Africa are Meeting this Threat." Nairobi: UNICEF, ESARO, 1-20.

United Nations Children's Fund China, (2014). *What Matters to UNICEF China*, UNICEF China, 2014, p. 11.

United Nations Children's Fund, (2015). *Unless We Act Now: The impact of climate change on children*, UNICEF, New York, November 2015, p. 8.

United Nations. (1998). Recommendations on Statistics of International Migration, revision 1. New York: United Nations.

Victora, C.G., (1992). The association between wasting and stunting: an international perspective. *Journal of Nutrition* 1992; 122:1105-1110.

Vilegon, K. (2000) food; Nutrition and Agriculture on a nutrition and household food security project in Vietnam, 37, Rome, pp.40.

Wachs, T.D., Georgieff, M., Cusick, S., and McEwen, B.S. (2014). Issues in the timing of integrated early interventions: contributions from nutrition, neuroscience, and psychological research. *Annals of the New York Academy of Sciences*.2014; 1308:89–106pmid:24354763

Weibel, D. (2008). *Demographic and health surveillance of mobile pastoralists in Chad:* integration of biometric fingerprint identification into a geographical information system. Geospatial Health 3(1):113-124.

WHO Multicentre Growth Reference Study Group, (2006). WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva: World Health Organization, 2006 (312 pages).

WHO Working Group, (1986). Use and interpretation of anthropometric indicators of nutritional status. *Bulletin of World Health Organization.*, 4: 924 -941.

WHO, UNICEF, UNU. (2001). Iron deficiency anaemia: assessment, prevention, and control. A guide for programme managers. Geneva, World Health Organization, 2001. WHO/ NHD/01.3.

WHO, (1993). Indicators for assessing iron deficiency and strategies for prevention. WHO/UICEF/UNU. Technical workshop. WHO, Geneva, Switzerland 1993.

Woods, M.N., (2006). Nutrition Assessment I & II. Available from http://ocw.tufts.edu/data/47/534622.pdf. {Accessed on 13.02.2017}

World Food Programme. (2000). *Food and Nutrition Handbook*. Rome: World Food Programme; 2000.

World Food Programme. 2005. *Food and Nutrition Handbook.* Rome.

World Health Organization, (1996). Guidelines for the control of iron deficiency in countries of the control of iron deficiency in countries of the Eastern Mediterranean, middle East and North Africa (WHOEM/NUT/177,E/G/II) 1996.

World Health Organization, (2009). "Global Prevalence of Vitamin A Deficiency in Populations at Risk 1995–2005." WHO Global Database on Vitamin A Deficiency. Geneva.

Yip, R and Dallman, P.R., (1988). The roles of inflammation and iron deficiency as causes of anaemia. *American Journal of Clinical Nutrition.* 1988; 48: 1295-1300.

World Health Organization, (2002). The world health report 2002 - Reducing Risks, Promoting Healthy Life available from http://www.who.int/whr/2002/chapter4/en/index3.html accessed on June 12 2017.

World Health Organization, (2009). *Global Health Risk Report Part 2*. Retrieved May 12 2017 from http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_part2.pdf&sa=U&ved=0ahUKEwiCiubilOrTAhXOLVAKHasNAusQFggSMAE&usg=AFQjCNG36hdZUHHTRP6HMeY3Tvsk0xbyKQ

World Health Organization, (2014). 10 facts on Nutrition. Available from http://www.who.int/features/factfiles/nutrition/facts/en/index2.html accessed on June 12 2017.

World Health Organization, (2017). Turning the tide of malnutrition, Responding to the challenge of the 21st century, available at: http://www.who.int/mip2001/files/2232/NHDbrochure.pdf. [Accessed September 11 2017].

World Health Organization, (2014). *Every Newborn: An action plan to end preventable deaths*, WHO, Geneva, June 2014, p. 17.

Wyss, K., Moto D.D., And Callewaert B. (2003). Constraints To Scaling-Up Health Related Interventions: The Case of Chad, Central Africa. *Journal of International Development* 15:87–100.

Yousafzai, A.K.; Rasheed, M.; and Bhutta, Z.A. (2012). "Annual Research Review: Improved Nutrition – A Pathway to Resilience." *Journal of Child Psychology and Psychiatry*. 54 (4), pp. 367–377.

Zinsstag, J. (2009) Towards a 'One Health' research and application tool box. Veterinaria Italiana 45(1):121-133.

Zinsstag, J., & Yosko, I. (2004). Pastoralisme nomade et sante´ au Tchad. *Revue de Me´decine Tropicale*, 64, 449–451.

Zinsstag, J., Taleb M. O., And Craig P. S (2006). Health of nomadic pastoralists: new approaches towards equity effectiveness. *Tropical Medicine & International Health* 11(5):565-568.

Zulkifli, S.N., Yu, S.M., (1992). The food frequency method for dietary assessment. *J. Am. Diet. Assoc. 92 (1992) 681-685.*

APPENDIX I

Table 1: Some Observed hygienic practices of the households

Character	Frequency		%age (%)	
Treatment of Water before drinking				
Untreated	150		53.76	
Boiling	45		16.13	
Filtering with a cloth	23		8.24	
Letting it settle	61		21.86	
Hand Washing Practices	**Yes**	**No**	**Yes**	**No**
After cleaning child faeces/defecating	125	154	44.80	55.20
Before/After Eating	96	183	34.41	65.59
Using of Soap	21	258	7.53	92.47
Method of Preserving Food				
Not covered in the open	15		5.38	
Covered in the open	82		29.39	
Kept inside living area (covered)	182		65.24	
Method of Preserving drinking water				
Stored in Clay pots (Covered)	201		72.04	
Left in the open	78		27.96	

More than half of the households (54%) did not use any water treatment method while only 16% boiled their water. Only 45% engaged in the hygienic practice of washing hands after defecating or cleaning a child with only 7% using soap. Water for drinking was preserved in clay pots with a cover by 72% of households.

APPENDIX II

Table 2: Infant Feeding Practices by Pastoralist Fulani Households in Kajuru LGA

	Yes		No	
Practice	**N**	**%**	**N**	**%**
Practiced exclusive breast feeding	-		279	100
Used locally available foods for complementary feeding	279	100	-	-
Fed child on demand	260	93.18	19	6.81
Fed Water/Animal milk before 3 months	279	100	-	-
Introduced Complementary feeding earlier than six months	54	19.35	225	80.65
Immediately initiated breastfeeding less than 1hr after birth	266	95.34	13	4.66

Exclusive breastfeeding was not practiced in any of the households but majority of children (93%) below 24 months were fed on demand. A high proportion of children (95%) were put to breast immediately or less than 1 hour after birth and locally sourced complementary foods was used by 100% of the respondents and most of them (80%) introduced these foods from six months as water and/or animal milk were also fed.

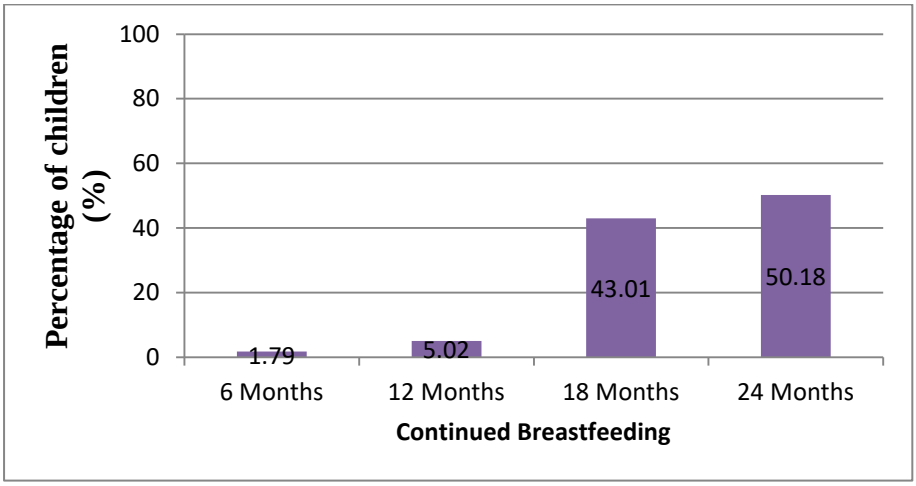

Figure II: Period of Breastfeeding

From the figure, 50% of children were breastfed till 24 months and 43% were stopped given breast milk at 18 months.

APPENDIX III

QUESTIONAIRE

DEPARTMENT OF BIOCHEMISTRY, AHMADU BELLO UNIVERSITY, ZARIA,

M.SC NUTRITION

RESEARCH TOPIC**: Influence of Seasonal migration on the dietary pattern, and Nutritional balance of Pastoralist Fulani Children (6-59mths) in *Kajuru* Local Government Area, Kaduna State**

Date: _____ Household No._____

Instruction: Please kindly provide answers to the following questions

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

(1) Name: ……

(2) Age: ……

(3) Gender: ……...

(4) Marital status: …….

(5) Religion (a) Islam [ ] (b) Christianity [ ] (c) Others [ ]

(6) Settlement location……..

(7) Previous Settlement……..

(8) Level of Education (a) Primary [ ] (b) Secondary [ ] (c) Others specify……..

(9) Occupation……

(10) What is the sex of household head? Male [ ] Female [ ]

(11) How many persons live in this household? .....

(12) No. of under 5 children in the family?.....

(13) Mother of the child (a) Alive and together [ ] (b) Alive and separated [ ]; (c) Dead [ ];

Father of the child (a) Alive and together [ ] (b) Alive and separated [ ]; (c) Dead [ ];

(14) What is the highest education level of Mother/caretaker of the child?

No School [ ] Primary [ ] Secondary [ ] Others, specify…….

(15) Source of Income?.....……..,.

(16) How many households members are currently earning an income?.....

Male [ ] female [ ]

(17) How many meals do household members in the following age groups eat per day**?**

Age Group **No. of meals**

A, Children 0-1 year _____

B, Children >1-5 years _____

C, Children >5-18 years _____

D, Members older than 18 years _____

SECTION B: ANTHROPOMETRIC MEASUREMENTS

- Name of the Child_____ _____
- Date of Birth: _____/_____/_____(DD/MM/YYYY)
- Place of Birth: _____
- Gender Male ☐ Female ☐

MEASUREMENTS

- Weight _____ (Kg)
- Height _____ (cm)
- Mid upper arm circumference_____ (cm)
- Hb Conc.:_____ (gldl)

APPENDIX IV

Food Frequency Questionnaire

Food Categories	**Never or Less than Once a Month**	**1-3 times Per Month**	**Once a week**	**2-4 times Per week**	**5-6 times per week**	**Once a day**	**2-3 times per day**
Cereals **Rice**: Boiled/White Jollof (*dagẹ-dagẹ/dafa duka*) *Túwon* rice Rice Cake *(masa/waina)* **Maize:** Boiled(with/without cob) Couscous(*Burabusko/Tsaki)* Maize Snack(*Punkasau/Màkala*) Pap(*kunu*) *Túwon Masara* **Sorghum:** Gruel (*gari)* Snack (*Punkasau)*							

Millet: Ground Millet mix (*Fura*) Pap *(Kunu)* Porridge *(nyiiri)*							
Root and Tuber **Cocoyam**: boiled **(Gwaza)** Roasted Porridge **Yam:** Boiled / Porridge Fried **Potato:** Boiled Fried **Irish Potato:** Fried **Cassava:**fried Cassava Cake(*rogo*)							
Dairy products and fats Fresh milk(*madara*) Sour milk (*nono*) Yoghurt (*kindirmo*) Local butter(*maishanu*) Cheese(*wara*)							

Meat, Fish and Poultry **Beef:** Boiled, fried, *Suya, Kilishi* **Lamb:** Fried, Roasted **Chicken:** Boiled, Fried **Fish:** boiled, fried **Eggs:** boiled, fried							
Legumes **Beans**: boiled Porridge Fried bean cakes (*kosai)* *Alele* *Dan-wake* **Groundnut:** Roasted G/nut Pap (*kunun gyada)* *kuli kuli* G/nut soup (*miyan gyada/dong* **Bambara nuts(***biriji*)**:**roasted Fried Soup							
Bread							

Pasta: Semolina							
Vegetables Soups and Sauces Sesame leaves(*Miyan Karkashi)* African sorrel(*Yakuwa/Miy* *Taushe)* Baobab leaves (*Miyan Kuka)* *Okra (*Miyan Kubewa) Moringa leaves(*Miyan Zogale/danb* Corchorus *(Rama*) Pumpkin (*kabewa)* Bitter leaves (*shuwaka)*							
Fruits and other Plants African Fan palm (*Giginya)* Figs (*Baure)* Tiger nuts *(aya)* Mango (*mangoro)* Sugarcane (*Raake)* Banana(*ayaba*) Cabbage(*kabeji*) Carrot(*karas*) Coconut(*kwakwa*) Dates(*dabino)* Guava(*gwaiba*) Lettuce(*latas*)							

Papaya(*gwanda*) Pineapple(*abarba*) Watermelon(*kankana*) Baobab(*kuka*) Pumpkin (*kabewa***)**							

- Are there any other foods you ate more than once a week? YES [ ] NO [ ]

  If yes, please List Below:

Food	**Number of Times Eaten Per Week**
_____	_____
_____	_____
_____	_____

APPENDIX V

Informed Consent Form

CONSENT TO PARTICIPATE IN RESEARCH

INFLUENCE OF SEASONAL MIGRATION ON THE DIETARY PATTERN, AND NUTRITIONAL BALANCE OF PASTORALIST FULANI CHILDREN (6-59MONTHS) IN KAJURU LOCAL GOVERNMENT AREA, KADUNA STATE

INTRODUCTION

You are kindly being asked to participate in a research study conducted by Nuraini Aisha for a Master of Science degree under the supervision of Prof. D.A. Ameh from the Department of Biochemistry, Faculty of Life Sciences, Ahmadu Bello University, Zaria.

If you have any questions or concerns about the research, please feel free to contact: Nuraini Aisha, Faculty of Life Sciences, Ahmadu Bello University, Tel: 08035695785; Prof. D.A. Ameh, Department of Biochemistry, Faculty of Sciences, Ahmadu Bello University, Tel: 08037037449

PURPOSE OF THE STUDY

The purpose of this project is to study the "influence of seasonal migration on the nutritional status of pastoralist Fulani children (6-59months) in Kajuru Local Government Area of Kaduna State". This study is in partial requirement for the award of M.Sc degree in Nutrition, Department of Biochemistry, Ahmadu Bello University, Zaria.

WHY IS YOUR CHILD BEING ASKED TO PARTICIPATE?

Your child is being invited because he/she is an under five child (6-59months) in Kajuru local Government of Kaduna State.

WHAT WILL HAPPEN DURING THIS STUDY?

Information pertaining demographics (i.e. age, sex, etc.), and frequency of some food intake will be collected using a questionnaire. The child's anthropometric measures will also be taken and samples of blood collected for analysis of some micronutrients.

POTENTIAL RISKS AND DISCOMFORT

This study does not pose any form of physical, emotional or psychological risks to you.

POTENTIAL BENEFITS TO PARTICIPANTS

The result of this study will help in assessing your nutritional status and factors that affect it. It can also help you make healthy choices pertaining to diet and health. This research work can also be used in planning, evaluation and advocacy in Kaduna State and can lead to the implementation of interventions to improve child health and survival.

WILL THERE BE ANY COST FOR PARTICIPATING?

Aside from your time, there are no costs in taking part in the study.

REMUNERATION FOR PARTICIPATION

Participation will not attract any financial benefit.

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information provided by participants in. You will not be identified in any reports or publications resulting from the study.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrants doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through Ahmadu Bello University Research Ethics Board. If you have any questions regarding your rights as a research participant, you can obtain further information about the research or voice your concerns to:

PROF. D.A. Ameh,

Department of Biochemistry,

Faculty of Sciences,

Ahmadu Bello University.

Tel: 08037037449

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I have read the information provided for the study "Influence of seasonal migration on the dietary pattern, nutritional and micronutrient status of pastoralist Fulani children (6-59months) in Kajuru Local Government Area of Kaduna State, Nigeria" as described herein. I have been given a copy of this form.

_____

Name of Participant

_____ _____

Signature of Participant Date

SIGNATURE OF PARENT/ GUARDIAN

_____

Name of parent/ guardian

_____ _____

Signature of parent/ guardian Date

APPENDIX VI

MINISTRY OF HEALTH, KADUNA STATE

All Communication to be addressed to:
THE HON. COMMISSIONER
Quoting Reference and Date
Telephone: 234-248048
Website: ttp://www/moh.kd.gov.ng.
Email: info@moh.kd.gov.ng.

Independence Way,
P.M/;B 2014
Kaduna.
Kaduna State, Nigeria.

Health Research Ethical Committee Kaduna State Ministry of Health

MOH/ADM/744/VOL.I/58

16th February, 2015

To.....

Ministry of Health Research Ethical Clearance

RE: INFLUENCE OF SEASONAL MIGRATION ON THE NUTRITIONAL STATUS OF PASTORALIST FULANI CHILDREN (6-59 MONTHS) IN KAJURU LOCAL GOVERNMENT AREA, KADUNA STATE

Name of Researcher : Nuraini, Aisha

Date of Receipt Application :

Date of Ethical Approval : 6th February, 2015

Research Period : 26th May, 2014 to June, 2015

You are kindly requested to give researcher maximum cooperation

However, it is mandatory for researcher to submit her findings to the ministry please.

F. A. Kura (Mrs.)
Secretary, Research Ethical Committee

APPENDIX VII

CHALLENGES FACED DURING RESEARCH

- Insecurity due to the activities of cattle rustlers and kidnappers
- Non-cooperation by some households as they were already living in fear due to rustlers and armed bandits
- Some areas were hard-to-reach due to the long distance in the bush and high level of grasses thereby posing an inability to transport serum from some areas due to rugged terrain and routes